UNIVAC

DATA PROCESSING DIVISION

1108

MULTI-PROCESSOR SYSTEM

PUNCHED CARD SUBSYSTEM

PROGRAMMER/OPERATOR REFERENCE MANUAL

UP-7506

This manual is published by the Univac Division of Sperry Rand Corporation in loose leaf format. This format provides a rapid and complete means of keeping recipients apprised of UNIVAC® Systems developments. The information presented herein may not reflect the current status of the product. For the current status of the product, contact your local Univac Representative.

The Univac Division will issue updating packages, utilizing primarily a page-for-page or unit replacement technique. Such issuance will provide notification of hardware changes and refinements. The Univac Division reserves the right to make such additions, corrections, and/or deletions as, in the judgment of the Univac Division, are required by the development of its Systems.

UNIVAC is a registered trademark of Sperry Rand Corporation.

PRINTED IN U.S.A.

CONTENTS

TABLES

1. INTRODUCTION

This manual contains information for the programming and operation of the Punched Card Subsystem for the UNIVAC 1108 Multi-Processor System.

It is assumed that both the programmer and operator have sufficient background information on the Central Processor and Main Storage of the UNIVAC 1108 Multi-Processor System and need only to be instructed in the use of the Punched Card Subsystem. Therefore material already covered in the "UNIVAC 1108 Multi-Processor System Processor and Storage Reference Manual," UP-4053 will not be duplicated here.

This manual is divided into three basic sections:

- Punched Card Subsystem Description

  This section will acquaint the reader with the characteristics of the Punched Card Subsystem.

- Programming

  This section supplies the user with the information required for programming for the Punched Card Subsystem.

- Operation

  This section contains the information necessary for the operation of the Punched Card Subsystem.

Referencing the programming section within this manual on a regular basis is unnecessary when appropriate software is available as an interface to the Punched Card Subsystem.

2. SUBSYSTEM DESCRIPTION

2.1. GENERAL

The Punched Card Subsystem for the UNIVAC 1108 System consists of a Card Reader, Type 0706, and/or a Card Punch, Type 0600 and a Card Control Unit, Type 5010. This latter unit communicates with the processor and controls the operation of both the Card Reader and the Card Punch.

The Card Reader senses 80-column data at the rate of 900 cards per minute maximum and transfers the data, column-by-column, to the Card Control Unit.

The Card Punch receives data from the Card Control Unit in the card image format, row-by-row, and punches and stacks cards at the maximum rate of 300 cards per minute.

The Card Control Unit decodes function words that are transmitted by the processor as instructions for the Card Reader or the Card Punch. This unit includes a buffer memory which collects the data characters read by the Card Reader, translates and sends the information to the processor. Likewise, data from the processor is translated by the Card Control Unit and sent to the Card Punch.

Some of the important features of the Punched Card Subsystem are:

- Stacker Selection

  The Card Punch output stackers are selectable during a punch operation by programmed instruction. The Card Reader is equipped with an Error Stacker which accepts cards should certain errors occur.

- Translation

  Card Code, row binary, and column binary are the modes of translation available under program control.

- Auto Recovery

  As an operator selectable option, the hardware of the Card Control Unit automatically repunches three cards of data and maintains proper card sequence upon detection of a punch error.

The capabilities and salient features of the individual units of the subsystem are presented in Tables 2–1 through 2–3.

PARAMETER	SPECIFICATION
CARD ORIENTATION	Fed face down, 9-edge leading
CARD RATE	900 cards per minute (maximum)
CARD CYCLE	66.6 milliseconds per card cycle at 900 cpm
INPUT HOPPER CAPACITY	3000 cards
READ STATION SENSING	Column-by-column
OUTPUT STACKER CAPACITY	
STACKER – Normal	2400 cards
STACKER – Error	100 cards

Table 2–1. Type 0706 Card Reader, Capabilities

PARAMETER	SPECIFICATION
CARD ORIENTATION	Fed face down, 9-edge leading
CARD RATE	300 cards per minute (maximum)
CARD CYCLE	200 milliseconds per card cycle at 300 cpm
INPUT HOPPER CAPACITY	1000 cards
READ STATION SENSING	Row-by-row
PUNCH STATION PUNCHING	Row-by-row
OUTPUT STACKER CAPACITY	
OUTPUT STACKER – Normal	850 cards
OUTPUT STACKER – Select	850 cards

Table 2–2. Type 0600 Card Punch, Capabilities

PARAMETER	SPECIFICATION
COMPUTER WORD LENGTH	36 bits
CHARACTER SIZE	6 bits
MODES OF OPERATION	Read and Punch
DATA INTERFACES:	
CARD CONTROL to/from PROCESSOR	36 bits parallel
CARD READER to CARD CONTROL	12 bits parallel
CARD CONTROL to CARD PUNCH	8 sequential transfers, 10 bits parallel

Table 2–3. Type 5010 Card Control Unit, Capabilities

2.2. CONFIGURATION

Equipment configurations for the Punched Card Subsystem are as follows: a Card Control Unit and either a Card Reader or a Card Punch or both. A block diagram of a sample configuration of the subsystem is shown in Figure 2–1. The names and type numbers of subsystem components are given in Table 2–4.

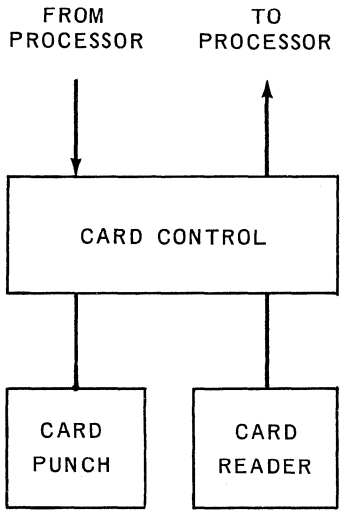


Figure 2–1. Punched Card Subsystem Block Diagram (Sample Configuration)

SUBSYSTEM COMPONENT	TYPE NO.	
	60 Cycle	50 Cycle
CARD READER	0706-99	0706-98
CARD PUNCH	0600-00	0600-04
CARD CONTROL UNIT	5010-00	

Table 2–4. Punched Card Subsystem Components

2.3. SUBSYSTEM COMPONENTS

Subsystem components, described in the following paragraphs, include the Card Reader, Card Punch, and the Card Control Unit.

2.3.1. Card Reader, Type 0706

The Card Reader, upon command from the processor, reads cards into the buffer memory of the Card Control Unit at a rate of up to 900 cards per minute, and then stacks the cards in the same order as originally fed. It is equipped with a control panel which is divided into two areas: the operator's control panel to initiate and monitor operation, and the diagnostic panel to diagnose malfunctions. See Figure 2–2.

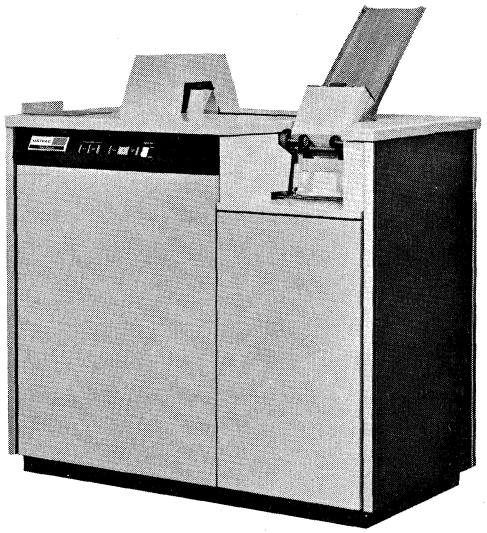


Figure 2–2. Type 0706 Card Reader

The functional units of the Card Reader are the Input Station, the Ready Station, the Read Station, the Error Stacker Station, and the Output Stacker Station. Station-to-station card flow proceeds in the sequence given below and is shown in Figure 2–3.

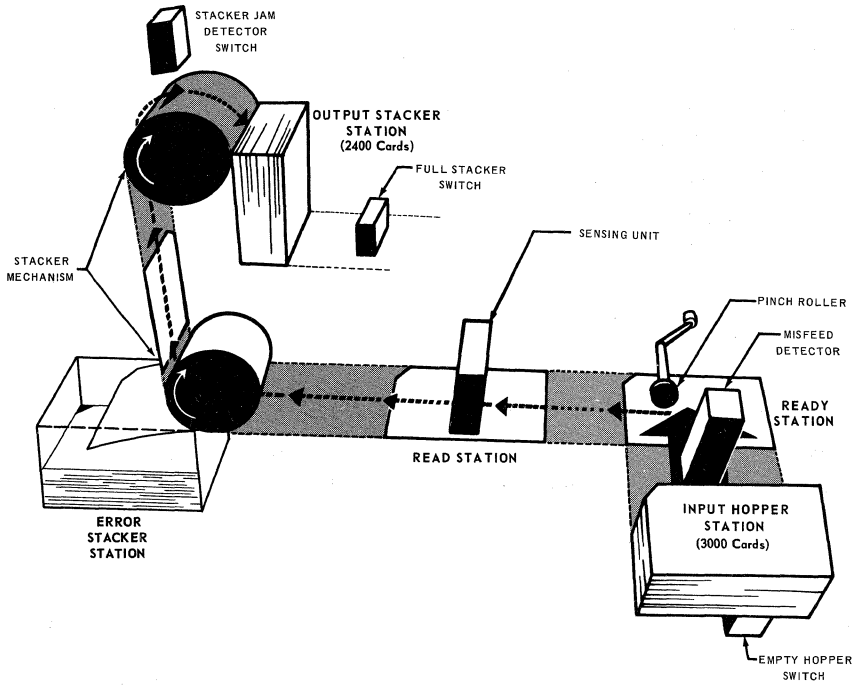


Figure 2–3. Card Reader, Block Diagram

1. The Input Station holds the cards to be read and initiates their travel through the reader.

   The primary components of the Input Station are the input hopper, picker knife, and misfeed detector. The purpose of each of these components is:

   - The input hopper is of the file-feed type and retains cards prior to being fed into the Ready Station. It is readily accessible to the operator so that cards can be added while the equipment is in use. The card capacity of the hopper is 3000 cards. A card weight must be placed on top of the card file to allow feeding of the last card.
   - The picker knife moves back and forth within the input hopper, feeding cards from the bottom of the file to the Ready Station upon receipt of a control signal from the Card Control Unit. If there are no cards remaining in the input hopper, the empty hopper switch energizes and places the reader in the nonready state.
   - The misfeed detector is a photocell which signals to the Control Unit whether a card has or has not been fed from the Input Station into the Ready Station following a feed signal. If a card has not entered the Ready Station (a misfeed has occurred), the Card Reader will be placed in the nonready state and the feeding of cards will be inhibited.

2. The Ready Station accepts the card fed to it from the Input Station, changes the direction of card movement, and holds the next card to be read. Once the card has entered the Ready Station, the Card Control Unit issues a control signal to activate the pinch roller (see Figure 2–3). The pinch roller transports the card into the Read Station.

3. The Read Station performs the data sensing function in the reader. Its major component is the sensing unit which contains twelve incandescent lamps and twelve photocell assemblies. When a card passes through the Read Station (between the lamps and the photocells), the data punched in the card will permit the appropriate photocells to be activated. The sensed data is stored in the Control Unit's buffer memory.

4. The Error Stacker Station is equipped with a card deflector which, when energized, intercepts and delivers a card to the Error Stacker. The Normal Stacker accepts all cards not delivered to the Error Stacker. Cards are deposited in the Error Stacker when the card deflector is energized by the detection of a defective photocell or a damaged card.

5. The Output Stacker Station is a 2400-card capacity stacker in which the cards are stacked on end. The cards are fed out of the Read Station into the stacker mechanism in an upward arc and deposited on end in the stacker tray. The stacker tray is readily accessible to the operator so that cards can be removed while the equipment is in use.

   Before entering the stacker, the cards pass by a jam detector switch which signals the control unit should a jam occur. The stacker is also equipped with a limit switch which closes to signal the control unit of a full stacker condition.

2.3.2. Card Punch, Type 0600

The Card Punch will feed, punch, post-punch read, and stack 80-column cards at a maximum rate of 300 cards per minute on command from the processor. It is equipped with a control panel which is divided into two areas: the operator's control panel to initiate and monitor operation, and the diagnostic panel to diagnose malfunctions. See Figure 2–4.

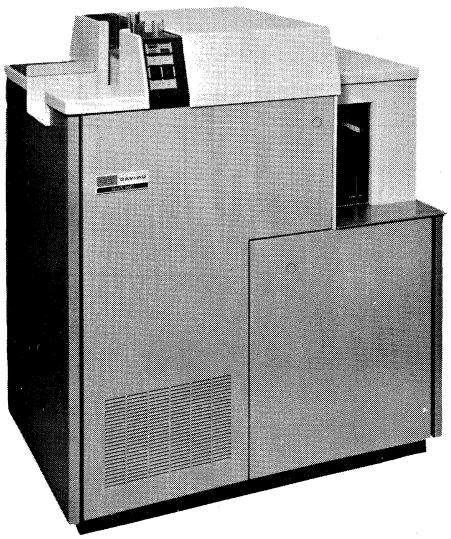
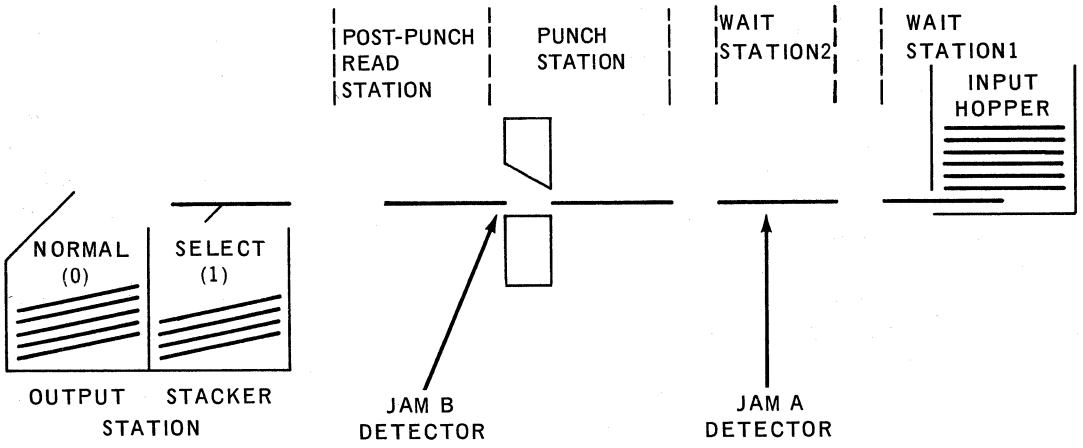


Figure 2–4. Card Punch, Type 0600

The Card Punch Feed Path is illustrated in Figure 2–5.



Note: Cards are depicted at rest between consecutive card punching cycles.

Figure 2–5. Card Punch Feed Path

A function word from the processor causes the cards to advance one station as follows:

1. Input Station

   The input hopper and the picker knife constitute the Input Station. The picker knife feeds cards, one at a time, from the bottom of the input hopper into the first pair of feed rolls.

2. Wait Station 1

   Wait Station 1 holds the card for one cycle of the clutched transport system.

3. Wait Station 2

   In Wait Station 2, two functions are performed: the card is held for another cycle of the clutched transport system, and the position of the card is checked. Upon entering Wait Station 2, the leading edge of the card is checked by a photocell, and the trailing edge is tested as the card leaves Wait Station 2. This is known as JAM A check. Any malfunction at this station will light the JAM A indicator on the control panel.

4. Punch Station

   The information received from the Card Control Unit's buffer memory is punched into the card in this station. As the card emerges from the Punch Station, the JAM B photocell checks the leading and trailing edge of the card for position or card jam. Any malfunction at this station will light the JAM B indicator on the control panel.

5. Post-Punch Read Station

   In the Post-Punch Read Station, the information that has been punched into the card is sensed and sent to the Card Control Unit for comparison with the information contained in the Card Control Unit's buffer memory for the purpose of verification.

6. Output Stacker Station

   The Output Stacker Station consists of two output stackers designated Normal and Select. The Select Stacker is equipped with a card deflector, which when energized, intercepts and delivers a card to the Select Stacker pocket. The Normal Stacker accepts all cards not delivered to the Select Stacker. The Punch function word received from the processor specifies whether the card goes to the Normal or the Select Stacker.

2.3.3. Card Control Unit, Type 5010

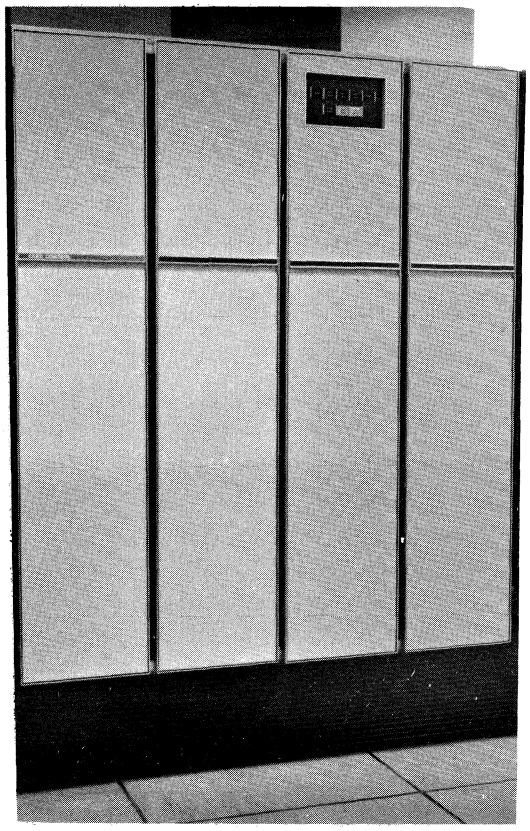


Figure 2–6. Type 5010 Card Control Unit

The Card Control Unit (see Figure 2–6) governs all the operations of the Punch Card Subsystem. Its principal functions are:

- to receive function words from the processor that condition and prepare the subsystem for different modes of operation and for data handling.
- to synchronize the flow of data between the processor and the Card Reader or Card Punch.
- to accumulate the data to be punched or being read from cards in its Buffer Memory.
- to interpret signals both normal and abnormal, from the Card Reader or Card Punch and to notify the processor of conditions within these units.

2.3.3.1. Buffer Memory

The Buffer Memory of the control unit is divided into eight areas, as follows:

- an input sense area which receives the data read from cards.
- an input translate area which is used as a table look up device for translation of data read from cards to processor code.
- two alternating input transfer areas which are used to store data from the input sense area in translated form and which are used as the source of data sent to a word assembly register for input to the processor.
- an output translate area which is used as a table lookup device for translation of output data (as it is received from the processor) to card code.
- three cyclically rotating output transfer areas which are used to store the translated or formatted data received from the processor following receipt of a Punch function, to send data to the punch station, and to send data to comparison circuits to check on the validity of data read at the post-punch check station of the punch unit.

3. PROGRAMMING

3.1. SUBSYSTEM/PROCESSOR INTERFACE

Communication between the processor and the Punched Card Subsystem is over a preassigned input/output channel. The channel contains 72 data lines (36 input and 36 output) and 7 control lines. The data lines provide for rapid parallel transfer of the 36-bit function, data, and status words. The control lines provide the various control signals that direct the Card Control Unit.

3.1.1. Control Signals

Various control signals (see Table 3–1) are provided to control and ensure the orderly flow of information between the processor and the Punched Card Subsystem. These signals do not transmit data but are used to command and to identify the transfer of information words at the proper times and the proper sequence. These control signals travel over the control lines of the channel associated with the subsystem.

SIGNAL	ORIGIN	MEANING	EFFECT
OUTPUT DATA REQUEST	Control Unit	Control Unit is ready to receive next output data word or function word.	Processor sends next output data word accompanied by an output acknowledge or next function word accompanied by an external function signal.
OUTPUT ACKNOWLEDGE	Processor	Processor has transmitted an output data word.	Initiates cycle whereby control unit accepts and processes output data word.
INPUT DATA REQUEST	Control Unit	Control Unit is ready to transmit next input word.	Processor accepts input word and sends input acknowledge.
INPUT ACKNOWLEDGE	Processor	Processor has received input word (data or status word).	Initiates cycle whereby control unit assembles next input word.
EXTERNAL INTERRUPT	Control Unit	Control Unit requires processor action.	Causes program to enter the interrupt subroutine.
EXTERNAL FUNCTION	Processor	Word on data lines is a function word.	Control Unit decodes function word.
MASTER CLEAR	Processor	MASTER CLEAR switch located on the System Control Console has been depressed.	Clears and restores the control unit to the translate mode.

Table 3–1. Control Signals

3.1.2. Communications Sequence

The Card Control Unit controls and handles all data transferred between the processor and the Card Reader or Card Punch. Two types of function words must be used to transfer data, the first to condition the control unit to handle data in a predescribed manner, and the second to initiate data handling and card movement (if specified).

- Conditioning Functions

  The Conditioning functions prepare the control unit to accept data transfers in the translate, card image by row, or card image by column modes.

- Data Handling Functions

  Once the control unit is conditioned to operate in one of the specified modes, a Data Handling function initiates all data transfers. The different forms of data transfers that may be specified by the Data Handling functions are as follows:

  Output – transfers data from the processor to the control unit for a card to be punched, and punches the data as soon as timing conditions permit.

  Input – transfers the data for a previously read card from the control unit to the processor and/or feeds one or more cards at the Card Reader.

3.1.2.1. Translate (Normal) Mode

The Card Control Unit is capable of translating between machine and card code on input or output functions. Translation to any code is accomplished by selection of the proper 6-bit machine or 12-bit card code located in the translate portion of the buffer memory. Table 3-2 shows standard translation from 80-column card code to Fieldata code on a reader to processor operation. Table 3-3 shows standard translation from Fieldata code to 80-column card code during a processor to punch operation.

3.1.2.2. Card Image by Row Mode

The Card Control Unit can transmit 80-column card images by row either from the Card Reader to the processor, or from the processor to the Card Punch. The image in each row consists of two full computer words plus a third word containing the eight bits of data needed to complete the binary row format. The remaining 28-bit positions of this third word are 0-bits for input data transfers and ignored on output data transfers.

3.1.2.3. Card Image by Column Mode

The Card Control Unit can transmit 80-column card images by column either from the Card Reader to the processor, or from the processor to the Card Punch. Each image consists of 26 full words of data (three columns per word) plus a word containing 24 bits of data needed to complete the binary column format. The remaining 12-bit positions of this 27th word are 0-bits for input data transfers and ignored on output data transfers.

80-COLUMN CARD CODE	PROCESSOR CODE OCTAL	PROCESSOR CODE BINARY	STANDARD PRINTER SYMBOL *	80-COLUMN CARD CODE	PROCESSOR CODE OCTAL	PROCESSOR CODE BINARY	STANDARD PRINTER SYMBOL *
0	60	110000	0 Ø	0-6	34	011100	W
1	61	110001	1	0-7	35	011101	X
2	62	110010	2	0-8	36	011110	Y
3	63	110011	3	0-9	37	011111	Z
4	64	110100	4	blank	05	000101	(space)
5	65	110101	5	12	42	100010	+
6	66	110110	6	12-0	54	101100	?
7	67	110111	7	12-3-8	75	111101	.
8	70	111000	8	12-4-8	40	100000	)
9	71	111001	9	12-5-8	01	000001	[
12-1	06	000110	A	12-6-8	43	100011	<
12-2	07	000111	B	12-7-8	03	000011	# (LF)
12-3	10	001000	C	11	41	100001	-
12-4	11	001001	D	11-0	55	101101	!
12-5	12	001010	E	11-3-8	47	100111	$
12-6	13	001011	F	11-4-8	50	101000	*
12-7	14	001100	G	11-5-8	02	000010	] ¢
12-8	15	001101	H	11-6-8	73	111011	;
12-9	16	001110	I	11-7-8	04	000100	Δ (CR)
11-1	17	001111	J	0-1	74	111100	/
11-2	20	010000	K	0-2-8	77	111111	≠ (or stop) ∧
11-3	21	010001	L	0-3-8	56	101110	,
11-4	22	010010	M	0-4-8	51	101001	(
11-5	23	010011	N	0-5-8	52	101010	% "
11-6	24	010100	O	0-6-8	57	101111	Ⓢ
11-7	25	010101	P	0-7-8	76	111110	□
11-8	26	010110	Q	2-8	46	100110	& –
11-9	27	010111	R	3-8	44	100100	=
0-2	30	011000	S	4-8	72	111010	'
0-3	31	011001	T	5-8	53	101011	:
0-4	32	011010	U	6-8	45	100101	>
0-5	33	011011	V	7-8	00	000000	@ ≪

* *Symbols are for both the High Speed Printer and the Console Printer. When two symbols are shown for a code, the symbol on the left is for the High Speed Printer, and the symbol on the right is for the Console Printer.*

Table 3–2. Standard Translation: 80-Column Card Code to Processor Code

PROCESSOR CODE		80-COLUMN	STANDARD	PROCESSOR CODE		80-COLUMN	STANDARD
BINARY	OCTAL	CARD CODE	PRINTER SYMBOL *	BINARY	OCTAL	CARD CODE	PRINTER SYMBOL *
000000	00	7-8	@ ≪	100000	40	12-4-8	)
000001	01	12-5-8	⌐ ≪	100001	41	11	–
000010	02	11-5-8	¬ ≫	100010	42	12	+
000011	03	12-7-8	# (LF)	100011	43	12-6-8	<
000100	04	11-7-8	Δ (CR)	100100	44	3-8	=
000101	05	blank	(space)	100101	45	6-8	>
000110	06	12-1	A	100110	46	2-8	& –
000111	07	12-2	B	100111	47	11-3-8	$
001000	10	12-3	C	101000	50	11-4-8	*
001001	11	12-4	D	101001	51	0-4-8	(
001010	12	12-5	E	101010	52	0-5-8	% "
001011	13	12-6	F	101011	53	5-8	:
001100	14	12-7	G	101100	54	12-0	?
001101	15	12-8	H	101101	55	11-0	!
001110	16	12-9	I	101110	56	0-3-8	,
001111	17	11-1	J	101111	57	0-6-8	\ Ⓢ
010000	20	11-2	K	110000	60	0	0 ø
010001	21	11-3	L	110001	61	1	1
010010	22	11-4	M	110010	62	2	2
010011	23	11-5	N	110011	63	3	3
010100	24	11-6	O	110100	64	4	4
010101	25	11-7	P	110101	65	5	5
010110	26	11-8	Q	110110	66	6	6
010111	27	11-9	R	110111	67	7	7
011000	30	0-2	S	111000	70	8	8
011001	31	0-3	T	111001	71	9	9
011010	32	0-4	U	111010	72	4-8	'
011011	33	0-5	V	111011	73	11-6-8	;
011100	34	0-6	W	111100	74	0-1	/
011101	35	0-7	X	111101	75	12-3-8	.
011110	36	0-8	Y	111110	76	0-7-8	□
011111	37	0-9	Z	111111	77	0-2-8	≠ (or stop) ⋀

* *Symbols are for both the High Speed Printer and the Console Printer. When two symbols are shown for a code, the symbol on the left is for the High Speed Printer, and the symbol on the right is for the Console Printer.*

Table 3–3. Standard Translation: Processor Code to 80-Column Card Code

3.1.3. Operation Types

The Punched Card Subsystem gives the program the capability of punching data on a card, of verifying the data punched, and of reading data from cards. The Card Control Unit provides the subsystem with these capabilities by making the following two types of operations available:

- Read Operation

  To initiate a read operation, the control unit is first conditioned to operate in one of the specified modes and the read operation begins only after the input data handling function (read) is received by the control unit. To condition the control unit for another mode, a new conditioning function must be sent. When the CHANNEL CLEAR button, located on the maintenance panel of the control unit, is depressed or if a Master Clear signal is received from the processor, and no conditioning function follows, the control unit operates in the translate mode when the input data handling function is received.

  When the data handling function specifying the read operation is received and decoded by the control unit, a feed signal is sent to the Card Reader. The card is automatically read by the reader and the data stored in the buffer memory is sent, upon request, to the processor in the format specified by the conditioning function.

- Punch Operation

  In order to initiate the punch and verify operation, the processor must first send a conditioning function to condition the subsystem for an output operation in row mode, column mode, or translate mode. When the CHANNEL CLEAR button, located on the maintenance panel of the control unit, is depressed or if the control unit receives a Master Clear signal from the processor and no conditioning function follows, the control unit operates in the translate mode upon receipt of an output data handling function (punch). Punch operation begins only after the data handling function is received by the control unit.

  When the data transfer (data received from the processor is stored in buffer memory) is completed, the advancing of all cards one station and the punching of a card are initiated as soon as timing conditions permit.

  As cards advance one station, the next card in the input hopper is fed into Wait Station 1. A card cycle after card 1 is punched, the card is sensed and the punched data verified by a bit-by-bit comparison. While the data in card 1 is being verified, card 2 is being punched.

  During this time, the data for card 3 can be transferred from the processor to the control unit. If a verification error is detected for card 1, it will not be reported to the processor until the Punch function specifying a data transfer for card 4 is received.

  At the completion of any output program, it is necessary to issue three additional Punch functions to the control unit to ensure that the last three cards punched by the output program have been verified and the last card has moved into an output stacker. A Terminate function should not be given at the completion of an output program until three additional Punch functions are issued, because it will override any possible error interrupts generated by the control unit.

3.2. WORD FORMAT

The Card Control Unit controls the operation of the Punched Card Subsystem through the following three types of 36-bit words: function words, data words, and status words. Each word type has its own format and is accompanied by a control signal to distinguish among the three types of words. Two of these (function word and data word) are classified as processor words; the third (status word) originates in the subsystem.

3.2.1. Function Words

As previously described in 3.1.2, two types of function words are sent from the processor to the control unit: (1) to set the mode of operation of the Card Control Unit, (2) to initiate data transfers and/or card movement. When the processor sends a function word to the control unit, it also activates the External Function line so that the control unit can recognize the function word. Figure 3-1 shows the format of the function word. Bit positions 35 thru 30 contain the 6-bit function code. The shaded area of the function word is ignored by the subsystem and may contain any combination of ones and zeros.

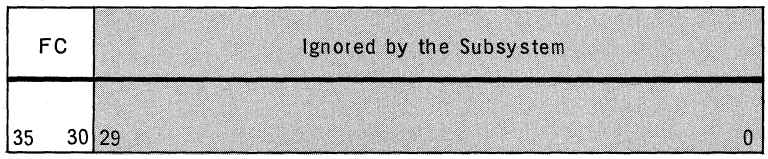


Figure 3–1. Function Word Format

The function code specifies the type of operation to be performed by the subsystem. Table 3-4 is a list of legal function codes.

OCTAL FUNCTION CODES		FUNCTION
WITHOUT INTERRUPT	WITH INTERRUPT	
02	12	Punch – Normal Stacker (0)
03	13	Punch – Select Stacker (1)
04	14	Condition Punch for Translate
05	15	Condition Punch for Card Image by Column
06	16	Condition Punch for Card Image by Row
23	33	Terminate
41	51	Transfer – No Trip
42	52	Transfer – Trip Fill
43	53	Trip One – No Transfer
62	72	Condition Reader for Translate
63	73	Condition Reader for Card Image by Column
64	74	Condition Reader for Card Image by Row

Table 3–4. Function Codes for the Punched Card Subsystem

For each basic function to be performed by the subsystem, there are two forms of function codes. One form specifies "without interrupt" and contains an even number in the most significant octal digit. The other form specifies "with interrupt" and contains an odd number in the most significant octal digit.

The differences in each basic function, as specified by the form of function code, are as follows:

(1) If the control unit has completed the data transfer for a function without detecting any error or abnormal conditions, the next function word can be accepted by the control unit when:

- the control unit turns on the Output Request signal following a function code that specified "Without Interrupt", or
- the control unit turns on the External Interrupt signal and the processor acknowledges receipt of the Normal Completion status word following a function code that specified "With Interrupt".

(2) If an error or abnormal condition is detected when a function is received or during the execution of the function, the control unit generates the appropriate status code and turns on the External Interrupt signal. After the processor acknowledges receipt of this status word, the next function word can be accepted by the control unit when:

- a terminate function is received following a function code that specified "Without Interrupt", because the Output Request signal is not turned on following an error response to this form of function code, or
- the Output Request signal is turned on following an error response to a function code that specifies "With Interrupt".

It is recommended that the "Without Interrupt" type of function code be avoided because it fails to notify the processor by an interrupt when the subsystem can accept the next function word.

3.2.1.1. Punch – Normal Stacker (0)

Function Codes: 02 Without Interrupt
12 With Interrupt

These functions instruct the subsystem:

- to accept data from the processor, store the function-related data in the buffer memory in the mode specified by the current Condition Punch function,
- to feed a card, advance all previously fed cards one station and punch the function-related data as soon as timing conditions permit, and
- to divert the card into the normal output stacker after the punched data is compared with (and found to be identical to) the function-related data stored in the buffer memory. If an error is detected during the compare process, the card is diverted to the select stacker.

3.2.1.2. Punch – Select Stacker (1)

Function Codes: 03 Without Interrupt
13 With Interrupt

These functions instruct the subsystem:

- to accept data from the processor, store the function-related data in the buffer memory in the mode specified by the current Condition Punch function.
- to feed a card, advance all previously fed cards one station and punch the function-related data as soon as timing conditions permit, and
- to divert the card into the select stacker regardless of whether or not the compare process performed shows that the punched data is identical to the function-related data stored in the buffer memory.

It is recommended that the Auto Recovery process (see 3.2.2.5) be disabled if the Punch – Select Stacker (1) function is to be used.

3.2.1.3. Condition Punch for Translate

Function Codes: 04 Without Interrupt
14 With Interrupt

This function conditions the control unit to translate the data to 80-column card code (see Table 3–3) and to store the translated data in the buffer memory for subsequent punching. The translate mode remains in effect until changed by a different Condition Punch function.

3.2.1.4. Condition Punch for Card Image by Column

Function Codes: 05 Without Interrupt
15 With Interrupt

This function conditions the control unit to store the data in the buffer memory in the format required for punching in the Card Image by Column mode. This mode remains in effect until changed by a different Condition Punch function or until the control unit is conditioned for translating output data by depressing the CHANNEL CLEAR switch on the control unit's maintenance panel or by receipt of a Master Clear signal from the processor.

3.2.1.5. Condition Punch for Card Image by Row

Function Codes: 06 Without Interrupt
16 With Interrupt

This function conditions the control unit to store the data in the buffer memory in the format required for punching in the Card Image by Row mode. This mode remains in effect until changed by a different Condition Punch function or until the control unit is conditioned for translating output data by depressing the CHANNEL CLEAR switch on the control unit's maintenance panel or by receipt of a Master Clear signal from the processor.

3.2.1.6. Terminate

Function Codes: 23 Without Interrupt
33 With Interrupt

This function instructs the control unit to conclude any operation in order to permit the subsystem to accept another function word.

The principal use of a Terminate function is to condition the subsystem to accept a function word following the processor's acknowledging the receipt of a status word for functions which specify "Without Interrupt." It is also used to initialize the subsystem at the start of a run.

Error or abnormal conditions involving a data transfer are not reported to the processor until the data transfer has been completed. Therefore, a Terminate function should not be sent to the subsystem until all of the data words are transferred for any one of the following functions: Transfer-Trip Fill function, Transfer-No Trip function, or a Punch function.

3.2.1.7. Transfer-No Trip

Function Codes: 41 Without Interrupt
51 With Interrupt

This function instructs the subsystem to send the data stored in the buffer memory for one card to the processor as soon as timing conditions permit. The number of data words made available to the processor is dependent on the mode for which the reader is conditioned. This function does not directly lead to the feeding of cards (see B2.1).

3.2.1.8. Transfer-Trip Fill

Function Codes: 42 Without Interrupt
52 With Interrupt

This function instructs the subsystem to send the data stored in buffer memory for one card to the processor and to feed as many cards to the reader as are necessary to fill the three card input area of the buffer memory. If the buffer memory does not contain input data, a total of four cards will be fed: one card to supply the requested input data and three more cards to fill the input areas.

The number of data words made available to the processor is dependent on the mode for which the reader is conditioned.

3.2.1.9. Trip One-No Transfer

Function Codes: 43 Without Interrupt
53 With Interrupt

This function instructs the subsystem to feed one card and store the data from the card providing there is space available. No data is transferred to the processor as a result of this function.

If this function is received at a time when one or two cards remain to be fed by a previously received Transfer-Trip Fill function, only one more card will be fed.

3.2.1.10. Condition Reader for Translate

Function Codes: 62 Without Interrupt
72 With Interrupt

This function conditions the control unit to translate data received from the reader to processor code (see Table 3–2).

The Translate mode remains in effect for data from the reader until one of the other Condition Reader for Card Image functions is received.

Precautions must be taken to insure that this function is not sent to the subsystem when there is data in the buffer memory. To do so may lead to subsequent erroneous data transfers and status codes. These error conditions may persist until the buffer memory is manually reloaded and initialized.

3.2.1.11. Condition Reader for Card Image by Column

Function Codes: 63 Without Interrupt
73 With Interrupt

This function conditions the subsystem to format the data read from each card for input to the processor in the Card Image by Column mode. The Card Image by Column mode for the reader remains in effect until one of the other Condition Reader functions is received or until the subsystem is conditioned for reading in the Translate mode by depression of the CHANNEL CLEAR switch on the control unit's maintenance panel or by receipt of a Master Clear signal from the processor.

Precautions must be taken to insure that this function is not sent to the subsystem when there is data in the buffer memory. To do so may lead to subsequent erroneous data transfers and status codes. These error conditions may persist until the buffer memory is manually reloaded and initialized.

3.2.1.12. Condition Reader for Card Image by Row

Function Codes: 64 Without Interrupt
74 With Interrupt

This function conditions the subsystem to format the data read from each card for input to the processor in the Card Image by Row mode. The Card Image by Row mode for the reader remains in effect until either of the other Condition Reader functions is received or until the subsystem is conditioned for reading in the Translate mode by depression of the CHANNEL CLEAR switch on the control unit's maintenance panel or by receipt of a Master Clear signal from the processor.

Precautions must be taken to insure that this function is not sent to the subsystem when there is data in the buffer memory. To do so may lead to subsequent erroneous data transfers and status codes. These error conditions may persist until the buffer memory is manually reloaded and initialized.

3.2.2. Status Word

The status word contains the status information generated by the Card Control Unit. When a function word specifying "With Interrupt" is issued, a status word is generated upon completion of the function. If a function word specifies "Without Interrupt", a status word is generated only if there is an error condition. The status word format is shown in Figure 3-2. Bit positions 35 thru 32 contain the 4-bit status code. The shaded area of the status word is ignored by the subsystem and may contain any combination of ones and zeros.

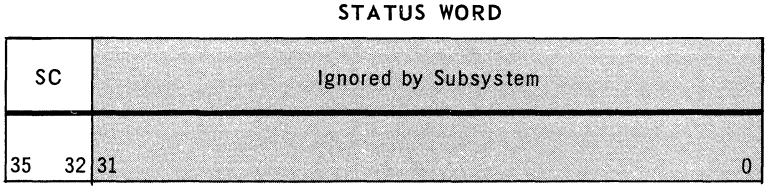


Figure 3–2. Status Word Format

Any operation may generate one of several status codes. A list of the various status codes is shown in Table 3–5.

OCTAL	BINARY	ERROR
20	0100XX	Synchronizer Sequence Error
30	0110XX	Synchronizer Counter Error
40	1000XX	Normal Completion
50	1010XX	Illegal Function Code
54	1011XX	Punch/Check Verification Error or Reader Light/Dark Check Error
60	1100XX	Inappropriate Function Code
70	1110XX	Illegal Character Code
74	1111XX	Interlock Fault

Table 3–5. Status Codes

Some of the status codes represent error conditions while others simply represent the normal conclusion of subsystem operations. In general, error conditions take precedence over normal conditions if the two should occur simultaneously. The action to be taken by the program on the occurrence of the external interrupt depends on the nature of the condition which caused the interrupt. For example, an Interlock Fault status code received as a result of a parity error suggests that one or more attempts should be made to reread the error card, or reissue the data to be punched as a recovery procedure. On the other hand, an Inappropriate Function Code status code indicates to the program that an improper sequence of legal instructions has been attempted.

Not all status codes can occur in response to all function codes. Table 3–6 indicates the possible status code responses to each of the function codes in the subsystem repertoire.

FUNCTION CODE	FUNCTION	STATUS CODE: Synchronizer Sequence Error (20 Code)	Synchronizer Counter Error (30 Code)	Normal Completion (40 Code)	Illegal Function Code (50 Code) **	Punch Check (54 Code)	Inappropriate Function Code (60 Code)	Illegal Character Code (70 Code)	Interlock Fault (74 Code)
02	Punch – Normal Stacker 0	X	X			X		X	X
03	Punch – Select Stacker 1	X	X			X		X	X
04	Condition Punch for Translate	X	X						X
05	Condition Punch for Card Image by Column	X	X						X
06	Condition Punch for Card Image by Row	X	X						X
12	Punch – Normal Stacker 0 W/I*	X	X	X		X		X	X
13	Punch – Select Stacker 1 W/I	X	X	X		X		X	X
14	Condition Punch for Translate W/I	X	X	X					X
15	Condition Punch for Card Image by Column W/I	X	X	X					X
16	Condition Punch for Card Image by Row W/I	X	X	X					X
23	Terminate								
33	Terminate W/I			X					
41	Transfer – No Trip	X	X			X	X	X	X
42	Transfer – Trip Fill	X	X			X		X	X
43	Trip One – No Transfer	X	X				X		X
51	Transfer – No Trip W/I*	X	X	X		X	X	X	X
52	Transfer – Trip Fill W/I	X	X	X		X		X	X
53	Trip One – No Transfer W/I	X	X	X			X		X
62	Condition Reader for Translate	X	X						X
63	Condition Reader for Card Image by Column	X	X						X
64	Condition Reader for Card Image by Row	X	X						X
72	Condition Reader for Translate W/I	X	X	X					X
73	Condition Reader for Card Image by Column W/I	X	X	X					X
74	Condition Reader for Card Image by Row W/I	X	X	X					X

W/I designates "With Interrupt".

***Illegal function code (50) can be generated by transmission of an undefined function code or faulty transmission of a defined function code.*

Table 3–6. Possible Status Code Responses to Function Codes

In the event that two or more error or abnormal conditions are detected during execution of a function, the status code priority sequence is as follows:

READER FUNCTIONS	PUNCH FUNCTIONS
30 Synchronizer Counter Error	30 Synchronizer Counter Error
74 Interlock (CU)	74 Interlock (CU)
50 Illegal Function	50 Illegal Function
60 Inappropriate Function	
54 Reader Light/Dark Check Error	54 Punch/Check Verification Error
74 Interlock (Reader)	74 Interlock (Punch)
70 Illegal Character Code	70 Illegal Character Code
20 Synchronizer Sequence Error	20 Synchronizer Sequence Error
40 Normal Completion	40 Normal Completion

3.2.2.1. Synchronizer Sequence Error

Status Code: 20

During data transfers to or from the subsystem, a three-stage counter in the control unit is used to control the assembly and disassembly of data words. This counter is recycled to zero when an error free data transfer is completed. If the counter is not at zero, the Synchronizer Sequence Error is reported to the processor by generating a 20 status code and turning on the External Interrupt signal.

3.2.2.2. Synchronizer Counter Error

Status Code: 30

The three-stage counter, which controls the assembly and disassembly of data words, is continuously monitored during any data transfer to or from the subsystem. For normal operation, the counter should sequence from zero through five and then return to zero. If the counter holds a count of six or seven, the function in progress is aborted. The Synchronizer Counter Error is reported to the processor by generating a 30 status code and turning on the External Interrupt signal.

3.2.2.3. Normal Completion

Status Code: 40

The Normal Completion status code is sent to the processor when the control unit considers a function which specified "With Interrupt" to be complete without detecting any error or abnormal condition.

3.2.2.4. Illegal Function Code

Status Code: 50

The Illegal Function Code status code is generated when a function word containing an undefined function code is received by the Card Control Unit.

3.2.2.5. Punch/Check Verification Error or Reader Light/Dark Check Error

Status Code: 54

During a punch operation, the data read from the card in the Post-Punch Read Station is compared with the data stored in the buffer memory. Should a verification error be detected, the PUNCH CHECK indicator located on the control panel of the punch will light.

Two types of operations to verify cards can be selected by the AUTO switch, located on the maintenance panel of the control unit. In either case, the Punch/Check Error status word is generated by the control unit and made available to the processor in response to the function word that requests the output data transfer for the third card after the card in error.

- If the AUTO switch is in the UP position, the card in error is diverted to the select stacker and operation of the punch stops.
- When the AUTO switch is in its normal (DOWN) position, the auto-recovery process takes place in the event of an error. The error card and the following two cards are diverted to the select stacker. All three cards of data are repunched from the buffer memory of the control unit and again verified. If an error is not detected on the second pass, the program continues and the error is not reported. If the error does occur, the punch unit stops and the error is reported.

During a read operation, the reader photocells are subjected to an all dark check when the leading edge of the card enters the photocell area and to an all light check when the trailing edge of the card leaves the area. Should an error be detected, the READ CHECK indicator located on the control unit operator's panel will light. The error card is diverted to the error stacker and the reader stops. The following card is also diverted to the error stacker if it is in motion when the error is detected. A Reader Light/Dark Check Error status code is generated by the control unit and made available to the processor in response to the function word that requests the input transfer of the data from the card in error.

3.2.2.6. Inappropriate Function Code

Status Code: 60

The Inappropriate Function Code status code is sent to the processor when an improper sequence of legal instructions has been attempted. Any of the following conditions will generate this interrupt.

- A Trip One-No Transfer function is attempted when the data from three cards is stored in the buffer memory;
- A Transfer-No Trip function is attempted with no data in the buffer memory, regardless of a card being in motion as a result of a Transfer-Trip Fill function. If a card is in motion as a result of a previous Trip One-No Transfer function and if there is no data in the buffer memory, the Inappropriate Function Code is not generated.

3.2.2.7. Illegal Character Code

Status Code: 70

The Illegal Character Code status code is generated by the control unit at the completion of an input data transfer for a card containing a card code not defined as legal by the translator.

3.2.2.8. Interlock Fault

Status Code: 74

The Interlock Fault status code is generated and made available to the processor for abnormal conditions in the Card Punch, Card Reader, or Card Control Unit. Conditions which can generate Interlock Fault are:

- Card Punch interlocks result from any one of the following environmental or operational abnormalities on the punch: overheat, cover interlock, hopper empty, stacker full, power fault, chip box full, or card jam.
- Card Reader interlocks result from any one of the following environmental or operational abnormalities on the reader: hopper empty, stacker full, power fault, misfeed, any card jam, or light/dark check.
- Card Control Unit interlocks result from any one of the following environmental or operational abnormalities on the control unit: overheat, power fault, test mode, and parity error. For a parity error, the interrupt is sent to the processor immediately upon detection of even parity when a character is read from the buffer memory.

3.2.3. Data Words

The data word contains the information to be punched or the information read. After the function word is received by the subsystem and acted upon, data words are sent to or from the processor. The data word is 36 bits long. The following format of data words corresponds to a full card of data depending on the mode of operation.

- Translate

  The Card Control Unit can transmit 80-column card images by character from the Card Reader to the processor, or from the processor to the Card Punch. The image read from or punched in each column is represented by six bits of the 36-bit data word. The 80-column card is represented by 14 (actually 13-1/3) data words. The unused portion of the 14th word, bits 23 to 00, is zero filled when reading and ignored when punching. Figure 3–3 shows the relationship of data words to card code.

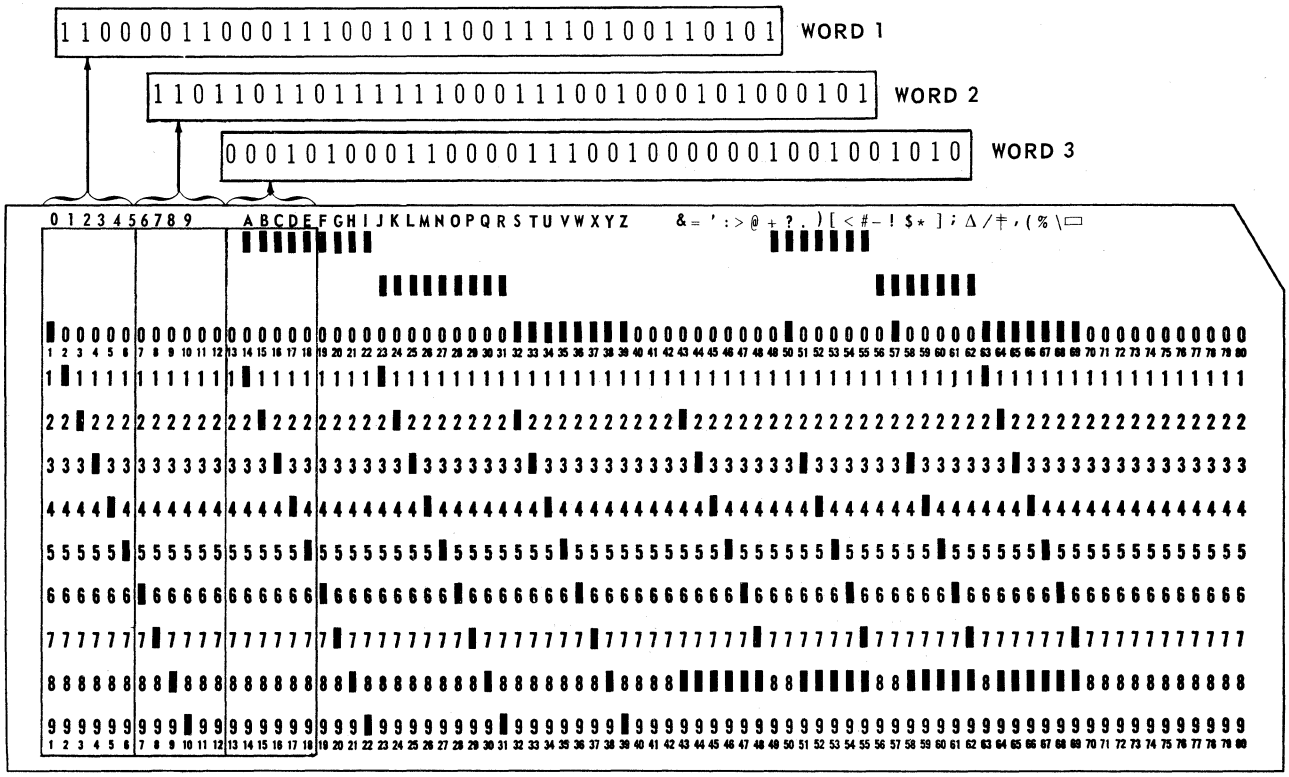


Figure 3–3. Relationship of Data Word to Card Code

- Card Image by Column

The Card Control Unit can transmit 80-column card images by column from the Card Reader to the processor, or from the processor to the Card Punch. Each 36-bit data word is represented by three consecutive columns of the punched card, as shown below in Figure 3–4. Note that the most significant bit position is the 12 row in column 1, and the least significant bit position is the 9 row in column 3 for the first 36-bit data word.

WORD 1	BITS 35–24	COLUMN 1
	BITS 23–12	COLUMN 2
	BITS 11–00	COLUMN 3
WORD 2	BITS 35–24	COLUMN 4
.	.	.
.	.	.
.	.	.
WORD 26	BITS 11–00	COLUMN 78
WORD 27	BITS 35–24	COLUMN 79
	BITS 23–12	COLUMN 80
	BITS 11–00	ZEROS WHEN READ, IGNORED WHEN PUNCHING

Thus in binary column format an 80-column card corresponds to 27 (actually 26-2/3) processor words.

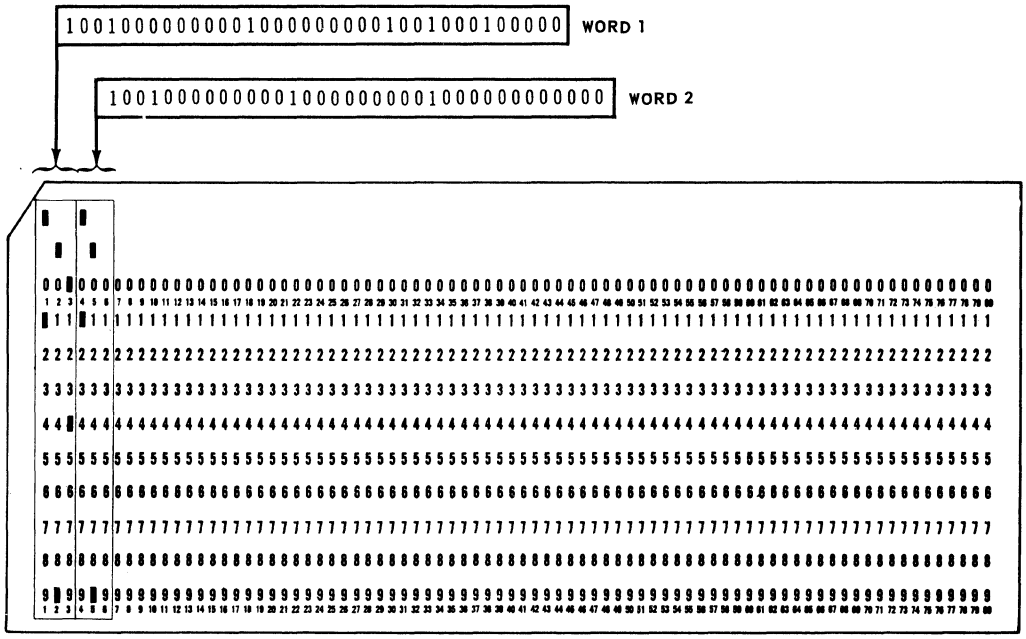


Figure 3–4. Relationship of Data Words to Card Punches, Card Image by Column

- Card Image by Row

The Card Control Unit can transmit 80-column card images by row from the Card Reader to the processor, or from the processor to the Card Punch. The image read from or punched in each row consists of two full processor words plus a third word containing eight bits of data in the most significant bit positions. When punching, these positions are ignored.

The first three processor words are read from or punched into the 12 row, the next three words are represented in the 11 row, and so on, as shown below and in Figure 3–5.

WORD 1	12 ROW, COLUMNS 1–36
2	12 ROW, COLUMNS 37–72
3	12 ROW, COLUMNS 73–80*
4	11 ROW, COLUMNS 1–36
	ETC.

**The remaining 28 least significant positions are zero filled when reading and ignored when punching.*

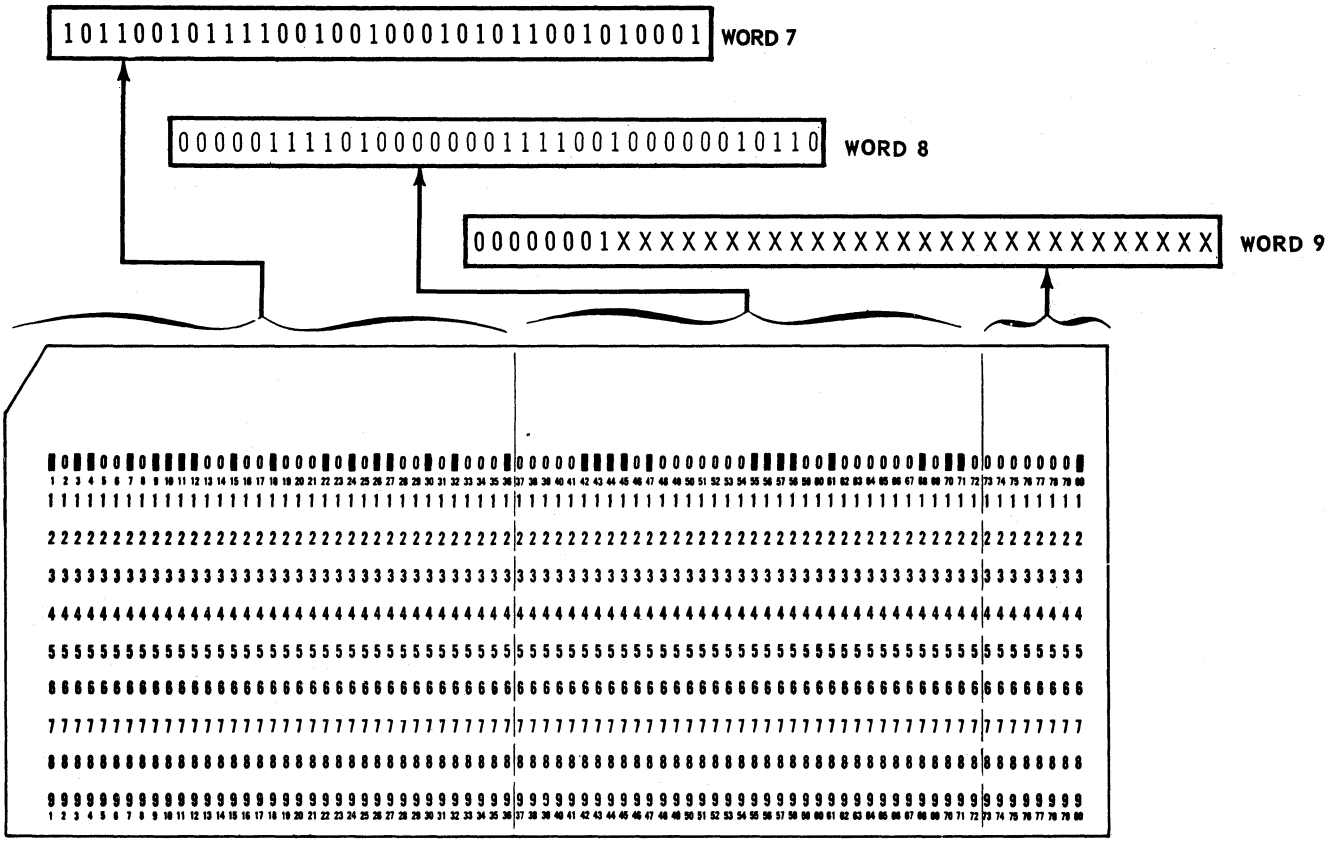


Figure 3–5. Relationship of Data Words to Card Punches, Card Image by Row

3.3. TIMING

There are two basic timing rules to be followed by the programmer and they are as follows:

- A function, other than Terminate, should not be sent to the subsystem following a "With Interrupt" function until the processor has received the status word for the previous "With Interrupt" function.
- A function, other than Terminate, should not be sent to the subsystem following a "Without Interrupt" function until the subsystem is prepared to accept the next function.

If these rules are not followed, proper execution cannot be expected for either the function which is followed too soon by another function, or the function which is sent to the subsystem prematurely. Appendix B gives a detailed timing description for the subsystem and assumes the above timing rules are not violated.

4. OPERATION

4.1. OPERATOR'S RESPONSIBILITIES

The Punched Card Subsystem operator is responsible for the following:

- Turning on and turning off the subsystem as required.
- Observing and responding to indications appearing on the various operator control panels described in this section.
- Performing the maintenance procedures described in this section.
- Seeing that the environment inside the room containing the subsystem is within the specifications given in A3. Any deviations from these specifications may lead to a decrease in system reliability.

4.2. CONTROLS AND INDICATORS

Controls and indicators on the components of the Punched Card Subsystem are described in the following paragraphs.

4.2.1. Card Reader

The Card Reader is equipped with an Operator's Control Panel and a Power Control Panel.

4.2.1.1. Card Reader Operator's Control Panel

The Card Reader Operator's Control Panel (Figure 4–1) permits the operator to control and monitor reader operations. Table 4–1 describes the operation of each component.

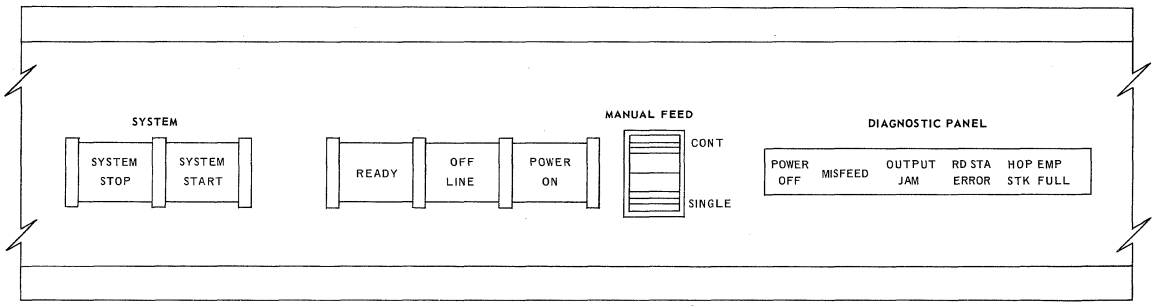


Figure 4–1. Card Reader Operator's Control Panel

MARKING	COLOR	FUNCTION AND INDICATION
SYSTEM STOP	Red	Momentary action switch. When pressed signals the control unit to stop operations and extinguishes SYSTEMS START indicator.
SYSTEM START	Green	Indicating switch. When the indicator is not lit and the system is in the READY state, depressing the SYSTEM START switch lights this indicator and signals the control unit to start operations. It should be noted that the SYSTEM START condition may be turned off by one of the following conditions: empty input hopper, stacker full, misfeed, output jam, read station error, interlock open, or power off. The System Started condition may also be turned off by an operator–indicated subsystem clear or by depressing the SYSTEM STOP switch.
READY	Green	Momentary action indicating switch. Lights when reader is ready to operate. Will not light if one or more of the following conditions occurs: hopper empty, stacker full, misfeed, output jam, read station error, interlock open, or power off. When pressed, will light all indicators (lamp test) on control panel. Depression of this switch also clears the 3-card buffer memory of the control unit. However, if the ready goes to a "ready" state (as the result of depression of this switch) subsequent depression of the READY switch will not clear the Control Unit buffer memory again until the "ready" condition is lost.
OFF LINE	White	Alternate action indicating switch. Pressing when not lit places reader off line and lights indicator. Pressing when lit places reader on line and extinguishes light.
POWER ON	Green	Alternate action indicating switch. Press to apply power to reader: lights when reader power is turned on. Pressing when lit turns reader off and extinguishes light.
MANUAL FEED CONT SINGLE	Three position nonindicating rocker switch that permits cards to be fed manually when the reader is off-line. The switch is spring loaded and rests in a neutral state unless depressed on either the CONT or SINGLE side. When the switch is depressed on the CONT side, cards will be continuously fed thru the reader. The SINGLE position (momentary action) allows cards to be fed one at a time.	
POWER OFF	Lights when an interlock opens or when there is no power to the drive motor or power control circuits.	
MISFEED	Lights when a card is not fed properly from the input hopper; (READY indicator is extinguished).	
OUTPUT JAM	Lights when a card jam in the stacker station is detected; (READY indicator is extinguished).	
RD STA ERROR	Lights when a read station jam is detected; (READY indicator is extinguished).	
HOP EMP STK FULL	Lights when last card is in the wait station. The next pinch signal starts this card moving into the read station. The data for the last 2 cards will be stored in the buffer memory, translated if specified, and ready for transfer to the processor. The interlock status code will not be sent to the processor until the input memory is empty. Lights when the normal output stacker is too full to accept additional cards.	

Table 4–1. Card Reader Operator's Control Panel

4.2.1.2. Card Reader Operator's Power Control Panel

The Card Reader Power Control Panel (Figure 4–2), located behind the front cover below the input hopper, contains five circuit breakers for voltage overload protection. Table 4–2 describes the operation of each component.

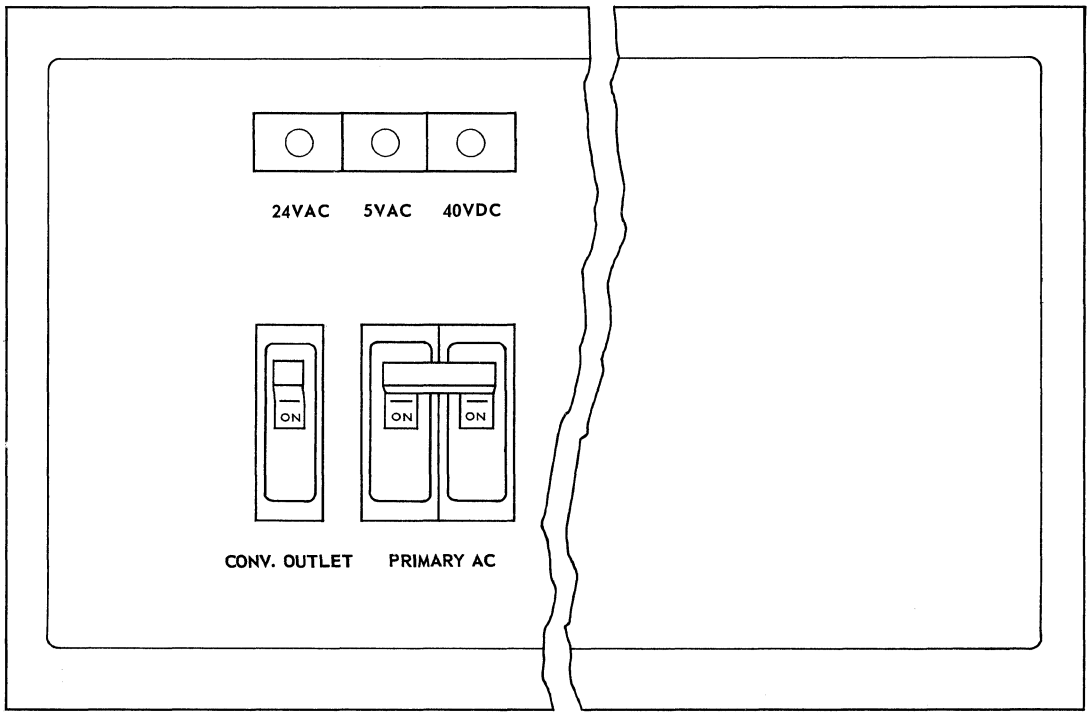


Figure 4–2. Card Reader Power Control Panel

4.2.2. Card Punch

The Card Punch is equipped with two control panels: the Operator's Control Panel, located on the front panel and the Power Control Panel, located at the lower right corner of the rear panel.

4.2.2.1. Card Punch Operator's Control Panel

The Card Punch Operator's Control Panel (Figure 4–3) permits control and monitoring of punch operations. Table 4–3 describes the operation of each item on the panel.

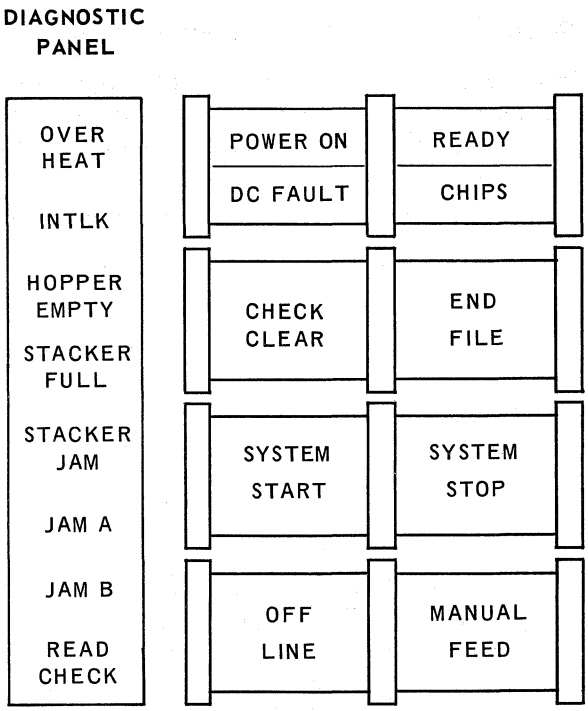


Figure 4–3. Card Punch Operator's Control Panel

4.2.2.2. Card Punch Power Control Panel

Card Punch Power Control Panel contains four circuit breakers for voltage overload protection. The breakers are located on one end of the panel and are shown in Figure 4–4.

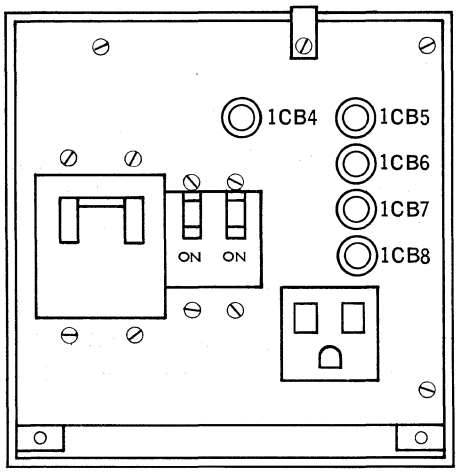


Figure 4–4. Card Punch Power Control Panel

These circuit breakers and their functions are described in Table 4–4.

MARKING AND TYPES	FUNCTION
24 VAC (pushbutton)	This circuit breaker, rated at 2 amps, is in series with the main power on-off control circuit. It acts as an overload breaker.
5 VAC (pushbutton)	This circuit breaker, rated at 1.5 amps, is in series with the 5 VAC to the POWER ON and POWER OFF and OFF LINE indicators. It acts as an overload breaker.
40 VDC (pushbutton)	This circuit breaker, rated at 4 amps, is in series with the 40 VDC connected to the clutch and brake circuits and the photo diodes. It acts as an overload breaker and manual on-off switch for these circuits.
CONV. OUTLET (toggle)	This circuit breaker, rated at 5 amps, is in series with the convenience outlet. It acts as an overload breaker for external equipment plugged into the convenience outlet.
PRIMARY AC (toggle)	This circuit breaker, rated at 15 amps, is in series with the main power entering the reader. It acts as an overload breaker and manual switch which interrupts power to the reader.

Table 4–2. Card Reader Power Control Panel

MARKING AND TYPE	COLOR	OPERATION AND FUNCTION
POWER ON DC FAULT (switch/indicator)	White Red	Momentary-action switch. Press to turn power on to unit. POWER ON portion of indicator lights, DC FAULT portion extinguishes. Press to turn power off. Indications are reverse of above. The DC FAULT portion of indicator lights approximately 5 seconds after any interlock is opened.
READY CHIPS (switch/indicator)	Green Yellow	Momentary-contact switch. Press to initiate punch-ready condition if all abnormal conditions are cleared. (This switch function is operative after motor is turned on.) Indicator lights when punch-control circuitry is ready to punch cards. Lights when chip box is full.
CHECK CLEAR (switch/indicator)	Yellow	Momentary-contact switch. Press to clear punch circuits. Enables operator to continue after a punch check error.
END FILE (switch/indicator)	White	Momentary-contact switch. When there are cards in Wait Station 1, Wait Station 2 and the Punch Station and no cards in the Input Hopper, pressing this switch followed by pressing of the SYSTEM START switch permits punching data in the last three cards and checking them without adding more cards to the input hopper. The indicator lights when the switch is depressed; it is extinguished when the "End-file" operation is completed. Since standard procedures require more than the exact number of cards to be placed in the input hopper, limited usage can be expected for the End-of-File operation.
SYSTEM START (switch/indicator)	Green	Momentary-contact switch. Press to initiate a system start from the punch. Lighted before three card run-in (see 4.5.2.3) and must be pressed to initiate the program.
SYSTEM STOP (switch/indicator)	Red	Momentary-contact switch. Press to initiate a stop from the punch which signals the control unit to stop operations on both the reader and punch.
OFF LINE (switch/indicator)	White	Alternate-action switch. Pressing when not lit places the punch offline and lights indicator. Pressing when lit places punch online and extinguishes light. (The punch must be offline for the MANUAL FEED switch to be operative.)

Table 4–3. Card Punch Operator's Control Panel
(Sheet 1 of 2)

MARKING AND TYPE	COLOR	OPERATION AND FUNCTION
MANUAL FEED (switch)	White	Alternate-action switch. When pressed, causes card feed as long as switch remains pressed. Switch can only be activated when punch unit is offline.
OVERHEAT (indicator)	Lights when temperature within the unit has exceeded 110°F or the blowers have failed.	
INTERLOCK (indicator)	Lights when an interlock switch within the unit is open.	
HOPPER EMPTY (indicator)	Lights when there are no cards in the Input Hopper.	
STACKER FULL (indicator)	Lights when output stacker is filled to capacity.	
STACKER JAM (indicator)	Lights when card jam in output stacker area.	
JAM A (indicator)	Lights when jam has occurred in the area of the Wait Station 2 as shown in Figure 4–13.	
JAM B (indicator)	Lights when jam has occurred in the area of the Post-Punch checking station as shown in Figure 4–13.	
READ CHECK (indicator)	Lighted by control unit when read check error is detected.	

Table 4–3. Card Punch Operator's Control Panel (Sheet 2 of 2)

MARKING AND TYPE	FUNCTION
DRIVE MOTOR (toggle)	Five-ampere circuit breaker for Drive Motor protection.
BLOWER (toggle)	One-ampere circuit breaker for Blower Motor protection.
LVPS (toggle)	Two-ampere circuit breaker for Low-Voltage Power Supply protection.
40 VPS (toggle)	Five-ampere circuit breaker with alarm contact for 40 VDC Power Supply protection.

Table 4–4. Card Punch Power Control Panel

4.2.3. Card Control Unit

The Card Control Unit is equipped with an Operator's Panel located on the front panel of the unit. This panel (Figure 4–5) permits monitoring and operation of the Card Subsystem. Table 4–5 describes the operation of each component of the panel.

4.3. SUBSYSTEM OPERATION

The following paragraphs describe the procedures for turning on the subsystem and for loading cards into the reader or punch.

4.3.1. Turn On Procedure

It is recommended that before initiating the procedure for turning on the subsystem, the operator completes the processor turn-on procedure. The individual units of the subsystem can now be turned on.

The recommended procedures for turn-on are as follows:

4.3.1.1. Card Reader Turn On

Before turning on the reader make certain that all cabinet panels are in place, that all interlocks are closed, and that maintenance work is not being done on the unit.

1. Depress POWER ON switch and then depress READY switch.
2. Inspect the Operator's Control Panel for indications of abnormal conditions. The remedial action to be taken for abnormal conditions is described in 4.4. If the condition persists, call the Univac Field Engineer.
3. If conditions are normal, press the POWER ON switch. The POWER ON indicator and the READY indicator will light.

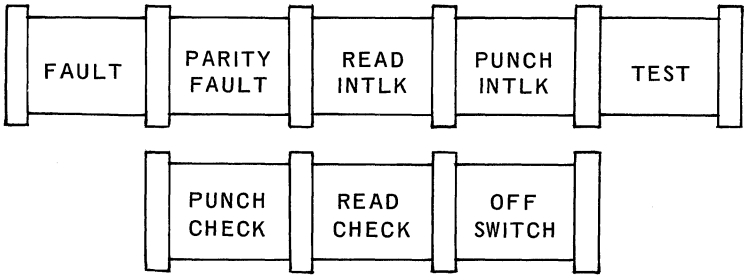


Figure 4–5. Card Control Unit Operator's Panel

MARKING	COLOR	OPERATION AND INDICATION
FAULT	Red	Switch indicator. Lights red whenever a fault occurs such as: interlock open, undervoltage or overcurrent condition in the control cabinet. When a fault has been detected and the condition causing the fault has been corrected pressing the FAULT switch extinguishes the indicator and clears the associated circuitry.
PARITY FAULT	Red	Indicator only. Lights red when a buffer parity fault is detected. The CHANNEL CLEAR, located on the control unit's maintenance panel, extinguishes the indicator switch.
READ INTLK	Red	Switch indicator. Lights red when reader is in an interlock condition. Pressing switch generates a read clear to control unit and reader.
PUNCH INTLK	Red	Switch indicator. Lights red when punch is an interlock condition. Pressing switch generates a punch clear to control unit and punch.
TEST	Red	Indicator only. Lights red when control unit is in TEST condition, or any non-normal operating condition.
PUNCH CHECK	Red	Switch indicator. Lights red when a punch check is detected. Pressing switch generates a punch clear signal to the control unit and punch.
READ CHECK	Red	Lights red when a light/dark check is detected. Pressing switch generates a read clear to the control unit and reader.
OFF	Green Red	Switch indicator. When pressed, turns off DC power to control cabinet. Lights green when DC power is on; lights red when AC power is on and DC power is off. When conditions require turning off DC power, it is necessary to call a Univac Field Engineer to reapply DC power.

Table 4–5. Card Control Unit Operator's Panel

4.3.1.2. Card Punch Turn On

Before turning on the punch make certain that all cabinet panels are in place, that all interlocks are closed, and that maintenance work is not being done on the unit.

1. Press the POWER ON switch. The POWER ON indicator will light and the DC FAULT indicator will be extinguished. Press the READY switch.
2. Inspect the Operator's Control Panel for indications of abnormal conditions. The remedial action to be taken for abnormal conditions is described in 4.4. If the condition persists, call the Univac Field Engineer for further maintenance.

4.3.2. Turn Off Procedure

When turning off the subsystem ensure that no card operations are in progress; then remove power from the units in the following sequence:

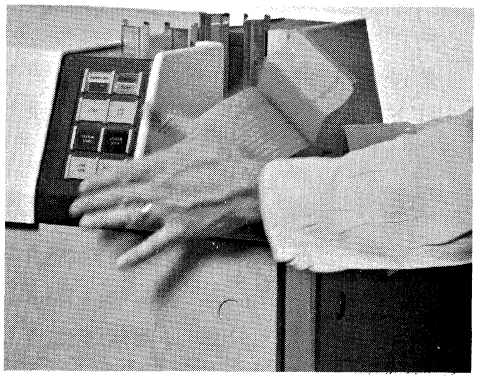
1. Card Reader: press POWER ON, indicator extinguishes.
2. Card Punch: press POWER ON, indicator extinguishes.
3. Card Control Unit: press OFF SWITCH, indicator lights red when DC power is off.

4.3.3. I/O Preparation

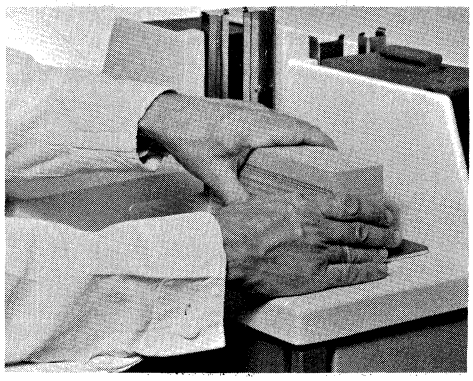
Before loading cards into the Card Reader or Card Punch, the operator must prepare the card deck to ensure proper feeding and movement through the card transport system. The procedure for loading cards is given below. Although the illustrations show the loading of cards into the Card Punch, the same principles are to be used by the operator when loading cards into the Card Reader.

4.3.3.1. Loading Cards

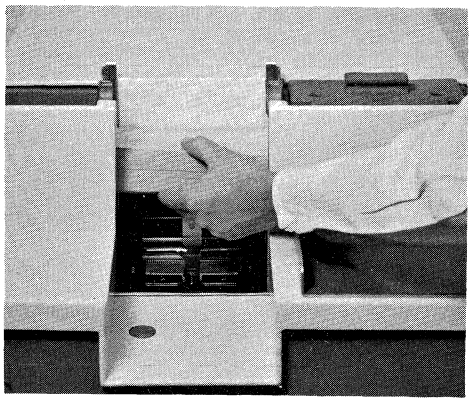
1. Before placing cards in the input hopper, first make certain that no cards in a deck are stuck together by fanning them as shown in Figure 4–6a. Next, jog the cards on the joggle plate (Figure 4–6b) to align them.
2. Place cards carefully into input hopper as shown in Figure 4–6c. Cards are placed face down, 9-edge leading. The card weight is placed on top of the cards after loading.
3. Cards may be removed from the input hopper by removing the card weight and depressing the card lifter. The deck may be removed from the hopper as shown in Figure 4–6d.
4. If cards are loaded and no fault indication appears on the panel, the unit is ready for operation. The initial three card run-in on the punch must be completed as described in 4.5.2.3 if there are no cards in the feed path. If routine cleaning is scheduled before operation, refer to 4.5.



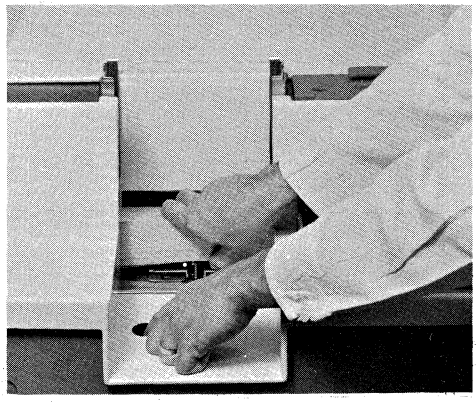
a. Card Fanning



b. Card Jogging



c. Placing Cards In the Input Hopper



d. Removing Cards

Figure 4–6. Card Handling and Loading

4.4. ERROR CONDITIONS AND CORRECTIONS BY OPERATOR

Error conditions in the subsystem consist of those conditions reflected in the status codes which accompany Internal Interrupts and those indicated by the diagnostic panels of either the Card Reader or Card Punch.

4.4.1. Interrupts and Error Recovery

The following paragraphs explain the interrupt conditions and operator recovery procedures required for the various interrupt conditions.

4.4.1.1. Punch Check Verification; Reader Light/Dark Check Error

Without Auto Recovery, a punch check error detected on card n returns the 54 interrupt to the processor in response to the external function requesting the output transfer for card n + 2. The error stacker contains three cards: the error card and the two succeeding cards. To recover from this punch check error, depress the PUNCH CHECK switch on the control unit operator's panel or on the punch operator's panel and resume the program.

With Auto Recovery (see 3.2.2.5), the 54 interrupt is generated when the punch check error is detected during the second punching pass. The initial error card and the two following cards plus the second error card and one of the duplicate cards are located in the error stacker. The second duplicate card is located in the card feed path just entering the post-punch read station. The operator should follow the conventions dictated by the site for an unrecoverable hardware error.

During a read operation, the light/dark check error causes the error card to be diverted to the error stacker. The 54 interrupt is generated by the control unit in response to Transfer-Trip Fill or Transfer Only functions for the error card. To recover from this error, remove the card in the error stacker, remove the card from the Ready Station and put these cards in the proper sequence at the bottom of the input hopper. Depress the READY switch and the START switch located on the Card Reader operator's panel and then advise the processor via the console keyboard that the Card Reader is ready for use. If the error occurs again, follow the conventions dictated by the site for an unrecoverable hardware error.

4.4.1.2. Inappropriate Function Code (Octal 60)

This interrupt indicates that an improper sequence of legal instructions has been attempted. Any of the following conditions resulting from a programming error will generate this interrupt:

- A Trip One-No Transfer function for the reader is received with the data from three cards in the buffer memory.
- A Transfer-No Trip function is received with no data in the input buffer.

4.4.1.3. Illegal Character Code (Octal 70)

This interrupt is sent to the processor at the completion of the transfer of data containing an illegal character or characters (translate mode only). The operator must follow the restart procedures as specified by the instructions of the program.

4.4.1.4. Interlock Fault (Octal 74)

This status code is sent to the processor for abnormal conditions in the punch, reader, or control unit. Operator can determine the source of interlock fault by observing the Control Unit operator's panel.

4.4.1.4.1. Control Unit

The 74 status is sent to the processor immediately upon detection of a parity error by the control unit. Parity errors require corrective action by maintenance personnel.

4.4.1.4.2. Punch

Punch interlocks indicate an abnormal condition in the punch and the 74 status will be sent to the processor as the response to a function word, requiring card movement in the punch. Reader operation is not affected by the punch interlock. A list of recovery procedures for punch interlock conditions follows.

- To recover from a punch interlock, the operator will correct any of the following abnormal conditions and then press the READY switch on the punch control panel:

  Overheat
  Interlock
  Hopper Empty
  Stacker Full
  Power Fault
  Chip Box Full

  Recovery from interlocks caused by card jams requires opening the punch and cleaning out the card path. After closing the punch, the READY switch should be pressed and the program restarted three cards back. If a Stacker Jam was the fault, it is possible that more than three cards of data could have been lost.

  Possible jam conditions are:

  Jam A
  Jam B
  Stacker Jam

- The last condition giving a punch interlock is punch offline. To recover, press the OFF LINE switch on the punch control panel and then press the READY switch.

4.4.1.4.3. Reader

Reader interlocks indicate an abnormal condition in the reader. If such a condition exists, the 74 status code will be sent to the processor in answer to a Trip One-No Transfer function or a Transfer-Trip Fill function when there is no input data in the buffer memory. Punch operation is not affected by a reader interlock.

To recover from a reader interlock, the operator must correct any of the following abnormal conditions and then press the READY switch and the SYSTEM START switch on the reader control panel:

Hopper Empty (See Table 4–1.)
Stacker Full
DC Power Fault

- Recovery from interlocks caused by card jams requires opening the reader and cleaning out the card path. Always follow the power off procedure for the reader before opening the reader cabinet. After closing the reader cabinet, press POWER ON switch, press READY switch, and then the SYSTEM START switch on the reader control panel.

  Possible jam conditions are:

  Misfeed
  Stacker Jam
  Read Jam

  The second condition giving a reader interlock is reader offline. Press the OFF LINE, READY, and SYSTEM START switches on the reader control panel to continue the program.

4.4.2. Card Reader Fault Diagnosis

Error recovery procedures for fault conditions indicated on the control panel of the Card Reader are listed in Table 4–6. References are made to procedural steps for corrective action contained in 4.5.

FAULT INDICATION	PROCEDURE
POWER OFF	Depress POWER ON switch. If POWER OFF indicator remains lit, call Univac Field Engineer.
MISFEED	Refer to 4.5.1.3, steps 1 through 6 for corrective action. If MISFEED indicator remains lit after correction, inform Univac Field Engineer.
OUTPUT JAM	Check output stackers for card jam. Clear jam according to procedures given in steps 31 through 47 of 4.5.1.3.
RD STA ERROR	Refer to 4.5.1.3, steps 7 to 20 and 21 to 30 to clear a Read Station error. If indicator remains lit after correction, call Univac Field Engineer.
HOP EMP STK FULL	Fill input hopper or empty output stackers. If fault persists, inform Univac Field Engineer.

Table 4–6. Operator's Procedures for Reader Fault Indication

4.4.3. Card Punch Fault Diagnosis

Error recovery procedures for fault conditions indicated on the control panel of the Card Punch are listed in Table 4–7. References are made to procedural steps for corrective action contained in 4.5.

4.5. OPERATOR PERFORMED MAINTENANCE

Operator performed maintenance instructions for the Card Reader and the Card Punch are presented in step-by-step form with illustrations to augment the text. These procedures do not require the use of tools.

4.5.1. Card Reader Maintenance Procedures

Maintenance to be performed by operator includes cleaning and inspection of the card feed track, offline operational check and when necessary, clearing reader card jams.

FAULT INDICATION*	PROCEDURE
POWER ON and DC FAULT both lit	Check circuit breakers on rear of punch; if all on, inform Univac Field Engineer.
CHIPS lit	Empty chip box. If indicator stays lit, inform Univac Field Engineer.
OVERHEAT lit	Inform Univac Field Engineer.
INTLK lit	Check all cabinet interlocks; if satisfactory, raise the top cover and check the brush block latch and punch locking lever (Figure 4-11). If all interlocks appear to be closed and interlock indication persists, inform Univac Field Engineer.
HOPPER EMPTY lit	Load input hopper. If indication persists, call Univac Field Engineer.
STACKER FULL lit	Empty output stackers. If STACKER FULL indication persists after emptying stacker and pressing the READY switch, inform Univac Field Engineer.
STACKER JAM lit	Check output stacker for card jam. Clear by following steps 5 through 9 of 4.5.2.4.
JAM A or JAM B lit	Refer to procedure under steps 1 through 4 of 4.5.2.4 to clear jams.
READ CHECK lit	Lights on detection of punch error during normal or auto recovery mode. Card which causes error drops into reject stacker. If lit while offline, inform Univac Field Engineer.

**After any fault occurs which is corrected by the operator, press the POWER ON and READY switches and refer to the operating instructions of the program being run for further procedures.*

Table 4–7. Operator's Procedures for Punch Fault Indications

4.5.1.1. Cleaning and Inspection of Card Feed Track

1. Press the OFF LINE switch; indicator lights when unit is offline.
2. Remove any cards from the input hopper by pressing the card release bar and lifting cards out.
3. Press the CONT side of the MANUAL FEED pushbutton to clear the card track of any cards.

CAUTION

Turn power off by pressing POWER ON switch; light should go out.

4. Raise the top cover of the Reader and secure with latching bar.
5. Wipe the feed rolls in the card feed track clean with a dry cloth. Clean the card feed track, the input hopper, and the general interior area with a vacuum cleaner. Close top cover and make certain that all interlocks are closed.
6. Press POWER ON and READY switches. If all other conditions are satisfactory, the operation of the unit should be checked before placing it online to the system.

4.5.1.2. Offline Operation Check

1. If the OFF LINE indicator is not lit, press the OFF LINE switch to place the unit offline.
2. Load the input hopper with about 1/4 to 1/2 inch of cards and press the CONT side of the MANUAL FEED pushbutton until no more cards drop into the output stackers. Cards are placed in the input hopper face down, 9-edge leading.
3. If the cards feed properly and no fault indications occur (except HOPPER EMPTY indication, which occurs after the last card is fed), the unit may be placed online to the system by pressing the OFF LINE switch (indicator) extinguishes).

4.5.1.3. Clearing Reader Card Jams

Three types of Reader card jams or errors may occur: misfeed, read station error, and output stacker jam.

a. Misfeed

1. Turn power off to unit by pressing the POWER ON switch (light extinguishes).
2. Raise and latch the top cover. Remove all cards from the input hopper. Inspect the cards at the bottom of the removed deck for bent edges or any other damage.
3. Remove all cards from the card feed path. Make certain that all removed cards are kept in their proper sequence.

NOTE: Reproduce all damaged cards and maintain the proper sequence.

4. Replace the cards in the input hopper.
5. Close the top cover.
6. Press POWER ON and READY switches (indicators light). Refer to the instructions for the program in operation for the correct restart procedures.

b. Read Station Error

A Read Station fault indication may be caused either by a card jam or by a light/dark check error. The correction of a card jam is described first.

The procedure for correcting a Read Station Error card jam is as follows:

7. Press POWER ON pushbutton to turn off power (indicator turns off).
8. Raise both top covers.
9. Remove cards from Normal Stacker (at rear of unit).
10. Loosen knurled knob on exit guide and raise guide.
11. Grasp left end (from rear) of stacker tray and raise up; a locking arm, connected to tray, will follow the tray and hold tray in up position.
12. Remove all cards except jammed card(s) from card feed path. Maintain correct card sequence.
13. Remove Read Station lamp assembly by unscrewing the knurled knobs at each side of assembly.
14. Rotate hand crank (knob) at left (from front) end of feed mechanism to remove damaged card.
15. Replace Read Station lamp assembly.
16. Grasp the left (from rear) end of stacker tray and lift slightly. Push locking arm to left and lower stacker tray into normal position (handle will be down).
17. Replace exit guide and tighten knurled knob.

NOTE: Reproduce all damaged card(s) and maintain the proper sequence.

18. Replace the cards in the input hopper.
19. Close the top cover; make certain that all interlocks are closed.
20. Press POWER ON and READY switches (indicators light). Refer to the instructions for the program in operation for the correct restart procedures.

The procedure for correcting a Read Station Error is as follows:

21. Repeat steps 1 through 5.
22. If there is no card jam, remove all cards from card feed path. Maintain correct card sequence.
23. Remove Read Station lamp assembly by unscrewing knurled knobs at each side of assembly.

24. Clean photocells immediately under Read Station lamp assembly with a clean cloth or vacuum cleaner.

25. Replace the Read Station lamp assembly.

NOTE: Reproduce any damaged card(s) and maintain the proper sequence.

26. Replace cards in the input hopper.

27. Grasp left (from rear) end of stacker tray and lift slightly. Push locking handle to left and lower stacker tray into normal position (handle will be down).

28. Replace exit guide and tighten knurled knob.

29. Close top cover and ensure that all interlocks are closed.

30. If RD STA ERROR indicator is extinguished, press POWER ON and READY pushbuttons (indicators light). Refer to instructions for program in operation for correct restart procedures. If RD STA ERROR indicator is still lit, or if fault recurs, inform Univac Field Engineer.

c. Output Stacker Jam

The procedure for correcting a card jam in the Normal Stacker is as follows:

31. Turn power off by pressing POWER ON pushbutton (indicator turns off).

32. Lift and latch top left cover.

33. Remove cards from stacker tray. Ensure that all cards remain in proper sequence.

34. At rear of machine, loosen knurled knob on stacker exit guide, raise guide, and remove damaged cards from top roll.

35. Replace guide and tighten knurled knob.

36. Reproduce all damaged cards and place them in their proper sequence.

37. Replace cards in stacker tray.

38. Close top left cover.

39. Press POWER ON and READY pushbuttons (indicators light). Refer to instructions for program in operation for correct restart procedures.

The procedure for correcting a card jam in the Error Stacker is as follows:

40. Turn power off by pressing POWER ON pushbutton (indicator turns off).

41. Lift and latch top left cover.

42. Remove cards from card path and error stacker. Ensure that card sequence is maintained.

43. Reproduce damaged cards.

44. Insert new cards in proper position with respect to cards removed.

45. Remove cards from input magazine. Place cards removed from alternate stacker and card path in bottom of magazine. Place cards removed from input hopper in proper sequence at bottom of file feed chute.

46. Close top left cover.

47. Press POWER ON and READY pushbuttons (indicators light). Refer to instructions for program in operation for correct restart procedures.

4.5.2. Card Punch Maintenance Procedures

Maintenance to be performed by the operator includes emptying the chip box, cleaning the card feed track, offline operational checks and when necessary, correcting card jams.

4.5.2.1. Emptying the Chip Box

1. Open the lower front cabinet panel (Figure 4–7).
2. Locate the chip box (Figure 4–8) and remove it from the unit.
3. Empty the chip box and replace it in the unit. Make certain that the cabinet interlock (Figure 4–9) closes firmly.

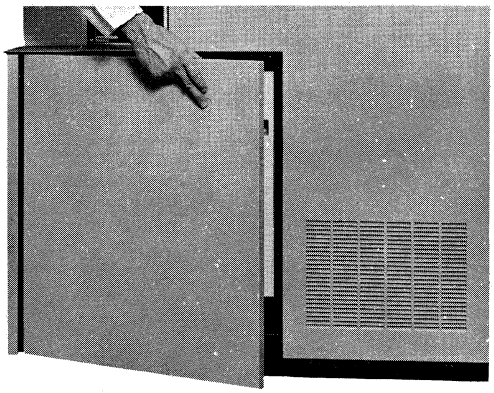


Figure 4–7. Front Cabinet Panel

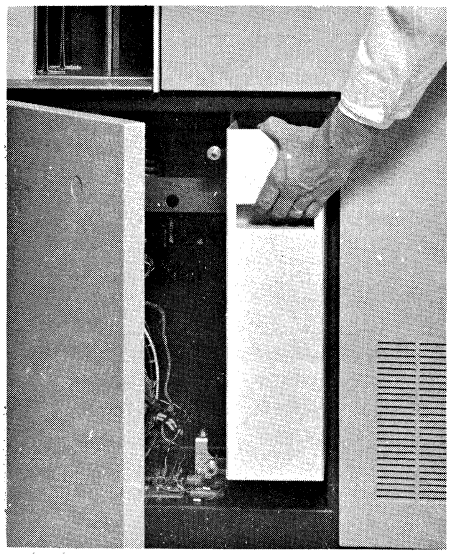


Figure 4–8. Chip Box

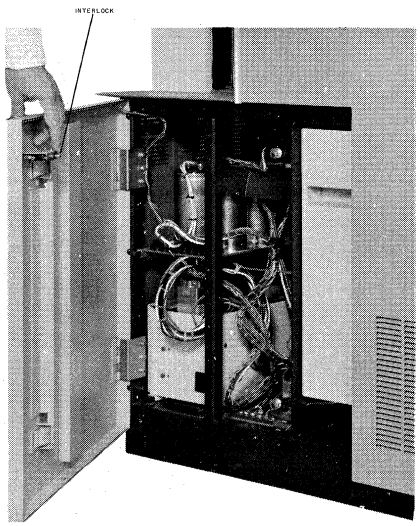


Figure 4–9. Chip Box Replacement

4.5.2.2. Cleaning the Card Feed Track

1. Turn off power to the unit by pressing the POWER ON/DC FAULT switch. The DC FAULT indicator lights when power is off.
2. Raise the top cover and latch it as shown in Figure 4–10.
3. Figure 4–11 shows the interior of the punch. All parts concerning the operator are labeled.

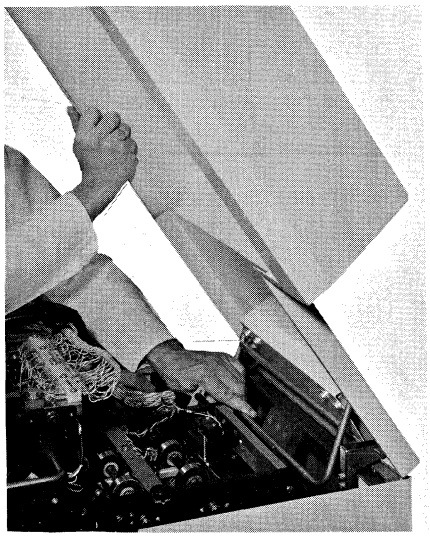


Figure 4–10. Latching Top Cover

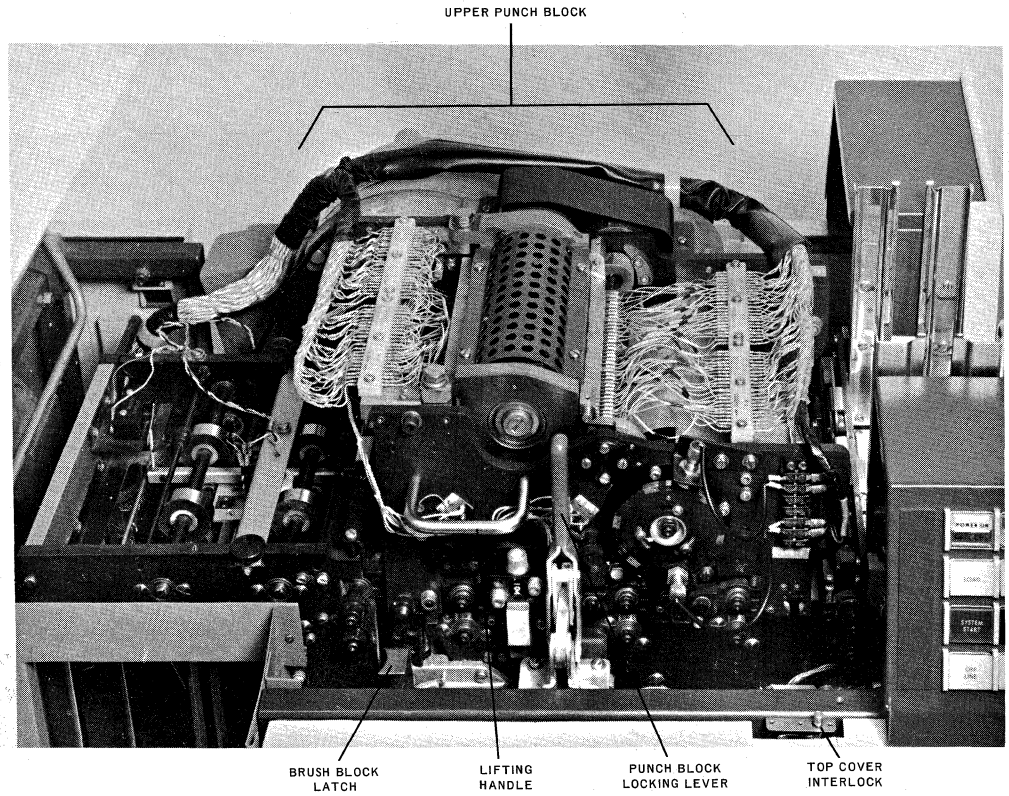


Figure 4–11. Details of Punch Interior

CAUTION

Raise the read brushes by releasing the brush block assembly locking lever to prevent damage to the brushes.

4. Unlock the upper punch block by releasing the punch block locking lever. Raise the block by the lifting handle as shown in Figure 4–12a.

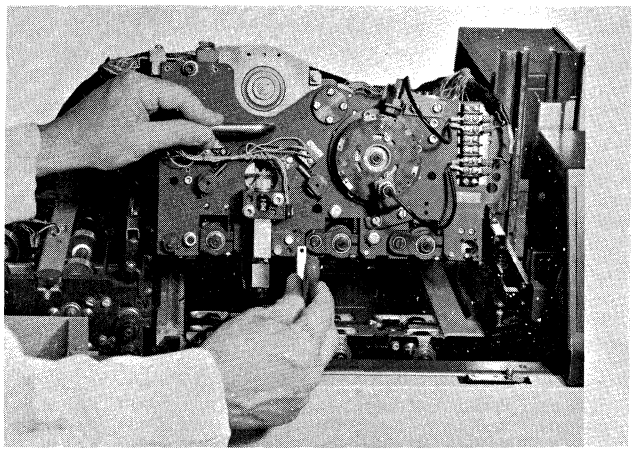
5. Clean the punch interior with a vacuum cleaner as shown in Figure 4–12b. Give special attention to the input hopper, the output stackers, and the punch mechanism.

CAUTION

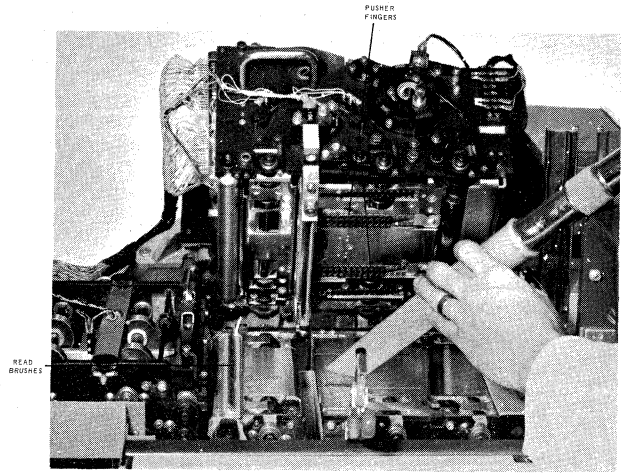
Whenever the punch block is open, be especially careful not to damage the pusher fingers or read brushes (Figure 4–12b).

6. Close the upper punch block and latch it carefully. Make certain to push in the brush block assembly locking lever (Figure 4–11) before closing the top cover.

7. Close the top cover and check to make certain that all interlocks are closed. An offline operational check should now be run before placing the unit on-line



a. Release and Raise Punch Block



b. Vacuuming Punch Interior

Figure 4–12. Cleaning the Punch Interior

4.5.2.3. Offline Operational Check

1. Apply power to the punch by pressing the POWER ON/DC FAULT switch.
2. Press the OFF LINE switch/indicator; the indicator should be lit for offline operation.
3. Press the READY/CHIPS switch/indicator; the READY portion should light.
4. Press the MANUAL FEED switch four times to load the card feed track.

CAUTION

The Punch must be primed (three cards in the feed track) manually before a card punch operation. Begin by performing steps 1 through 4, if there are no cards in the feed track. Press the SYSTEM START switch and then place the unit online by pressing the OFF LINE switch (indicator lights).

5. If any fault indications light and stay lit during offline or online operation, refer to Table 4–7 for the procedure to follow.

4.5.2.4. Card Jam Correction

Several types of card jams may occur in the punch. These include STACKER JAM, JAM A, and JAM B. Most jams are fairly obvious and not too difficult to correct. A representative example is given in the following steps for general familiarization with card jam correction.

a. Jam A, Jam B

1. If a jam occurs, repeat steps 1, 2, and 4 of 4.5.2.2 and refer to Figure 4–13 for the normal appearance of the punch interior with cards in the card track.

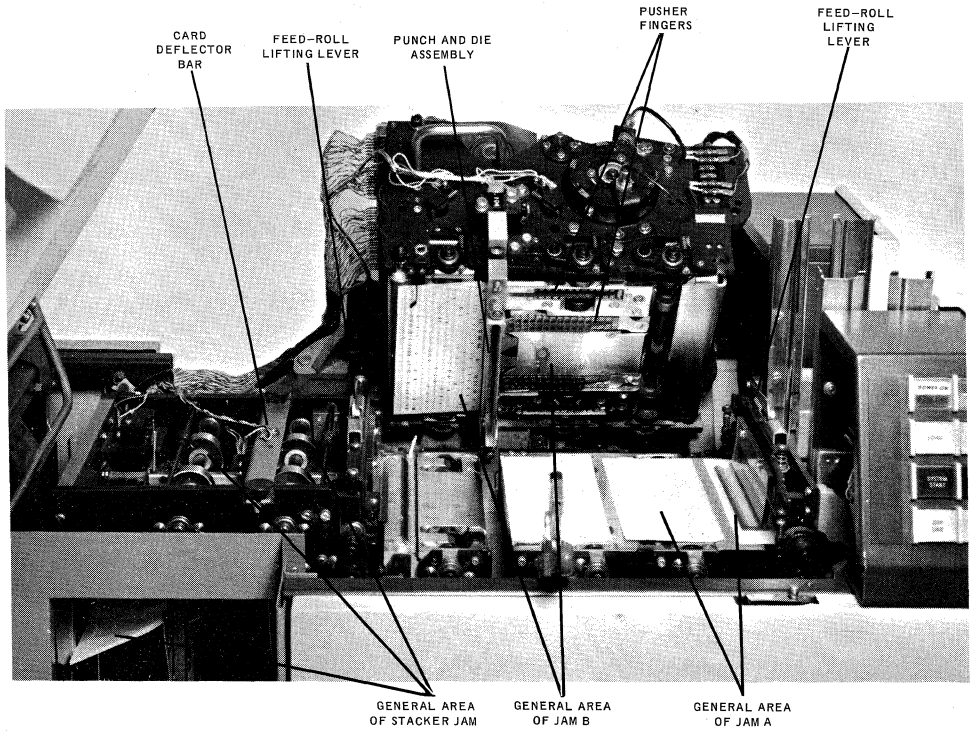
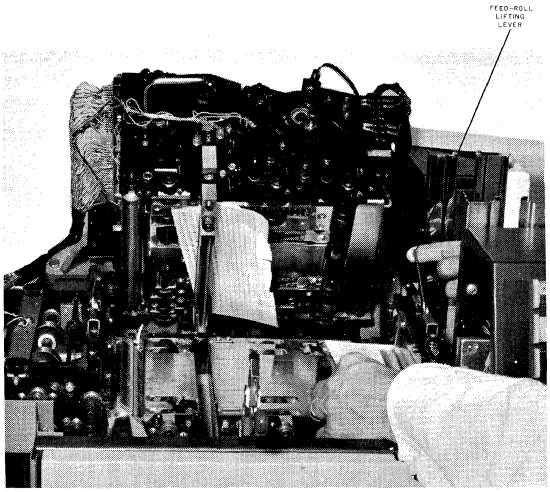
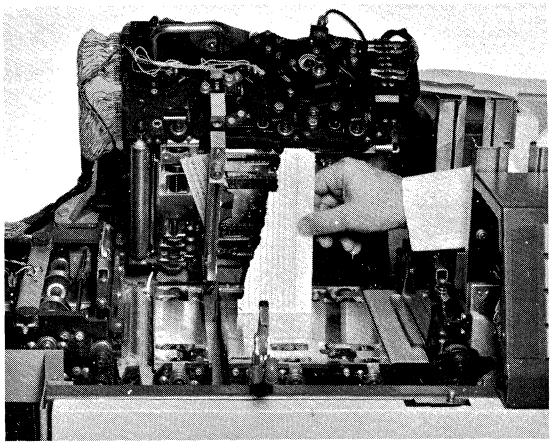


Figure 4–13. Punch Interior with Cards Loaded

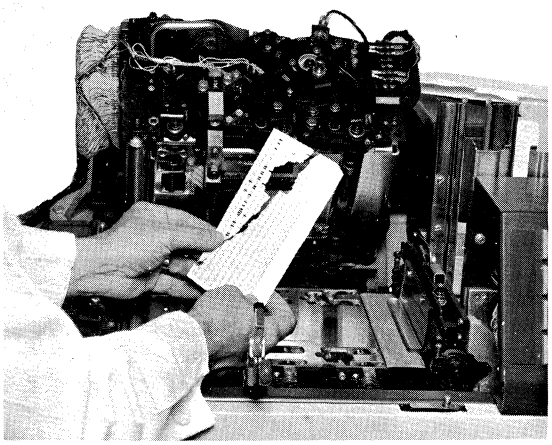
2. Figure 4–14a is the same view as Figure 4–13 but with a card JAM B. Remove cards from the card feed track. The card under the feed roll is removed by raising the feed roll, lifting lever as shown in Figure 4–14a.
3. Tear the jammed card along the rear edge of the punch die (Figure 4–14b). Pull out the remainder of the card in the direction shown by the arrow in Figure 4–14b and compare the pieces (Figure 4–14c) to see if any card fragments are still in the punch.



a. Remove Cards From Track



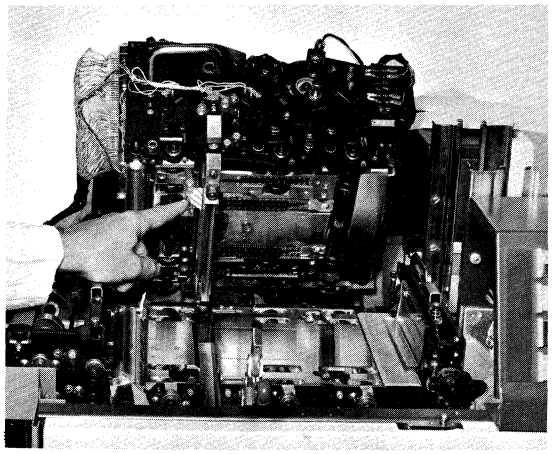
b. Remove Jammed Card(s)



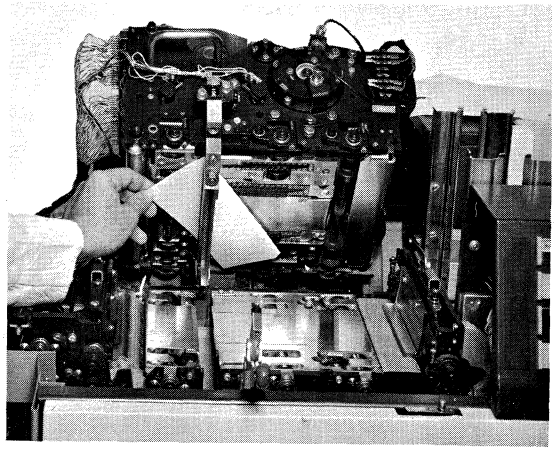
c. Compare Pieces for Missing Card Fragments

Figure 4–14. Card Jam Correction (Sheet 1 of 2)

4. Locate the missing card fragment (Figure 4–14d), if any, and remove it by sliding another card through the punch-and-die assembly (Figure 4–14e) in the direction shown by the arrow. Slide a card through the punch-and-die assembly even if there are no apparent missing fragments. If the card will not slide through, call the Univac Field Engineer. Repeat steps 6 and 7 of 4.5.2.2.



d. Locate Any Missing Fragments



e. Remove Fragments with Another Card

Figure 4–14. Card Jam Correction (Sheet 2 of 2)

b. Stacker Jam

5. Figure 4–15a is an example of a stacker jam.

   NOTE: It is not necessary to raise the upper punch block to correct a stacker jam.

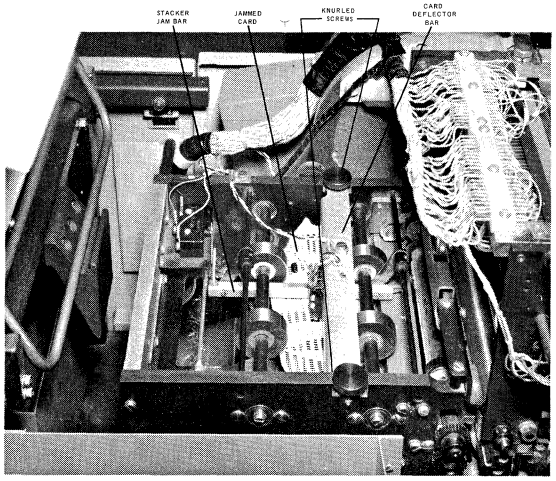
6. Usually, the jammed card can be lifted out easily without removing any hardware, but, in some cases, the card deflector bar (Figure 4–15a) must be removed.

7. Remove the card deflector bar by loosening the knurled screws at either end of the bar. Lift the bar out as shown in Figure 4–15b.

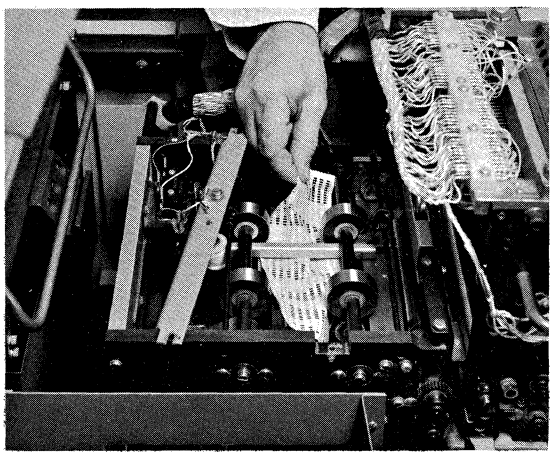
8. Remove the jammed card and replace the card deflector bar.

9. Close the top cover. Make certain that all cabinet interlocks are closed.

   NOTE: Press the POWER ON switch and the READY switch and follow the correct restart procedures specified by the instructions for for the program in operation.



a. Remove Card Deflector Bar



b. Remove Jammed Card

Figure 4–15. Stacker Jam

APPENDIX A. SUMMARY OF PHYSICAL AND OPERATIONAL REQUIREMENTS

A1. PHYSICAL CHARACTERISTICS

The physical characteristics of the individual units comprising the Punched Card Subsystem are contained in Table A–1.

DIMENSIONS	UNIT NAME		
	CARD CONTROL	CARD READER	CARD PUNCH
Height (inches)*	64	57	48.5
Width (inches)	48	40	42.2
Depth (inches)	34	25	25
Weight (pounds)	500	550	800

**Plus jackpads with 0 to 2 inches of adjustment.*

Table A–1. Physical Characteristics

A2. HEAT DISSIPATION

The amount of heat dissipation by the various units is as follows:

Card Control Unit: 2600 BTU/hr
Card Reader: 3420 BTU/hr
Card Punch: 4800 BTU/hr

A3. ENVIRONMENTAL REQUIREMENTS

The environmental requirements of the Punched Card Subsystem consist of supplying its components with air conditioning to the specifications in Table A–2.

REQUIREMENTS	UNIT NAME		
	CARD CONTROL UNIT	CARD READER	CARD PUNCH
Operating Temperature	62° to 82°F	50° to 90°F	50° to 90°F
Humidity	30% to 70%	20% to 75%	20% to 85%

Table A–2. Environmental Requirements

Each unit is equipped with its own blower for the proper utilization of this air. The amount of air required per unit is:

Card Control Unit: 390 cfm via false floor plenum
Card Reader: 270 cfm nominal air flow, room air only
Card Punch: 350 cfm nominal air flow, room air only

A4. ELECTRICAL REQUIREMENTS

The electrical requirements for the units comprising the Punched Card Subsystem are given below.

A4.1. CARD CONTROL UNIT

Regulated Voltage

Voltage:	208 vac ± 1%, 400 cps, 3 phase (4 wire)
Line Current:	0.7 kva
Source:	Motor-Alternator

Unregulated Voltage

Voltage:	120 vac, 60 cps, 1 phase, 1.7 kva
Voltage:	208 vac, 60 cps, 3 phase, 0.36 kva

A4.2. CARD READER

Voltage (vac):	190/260
Frequency (cps):	50 or 60
Phase:	Single (3-wire)
Line Current (amp):	15

A4.3. CARD PUNCH

Voltage (vac):	190/260
Frequency (cps):	50 or 60
Phase:	Single (3-wire)
Line Current (amp):	15

A5. SUBSYSTEM CABLING

Power and interunit cables enter each cabinet at the bottom, either from a false floor or by a surface raceway. Maximum allowable cable lengths are given in Table A–3.

USED BETWEEN	FUNCTION	NUMBER USED	MAXIMUM LENGTH
Processor and Card Control Unit	Input channel	1	200 feet
Processor and Card Control Unit	Output channel	1	200 feet
Card Control Unit and Card Reader	Data line	1	100 feet
Card Control Unit and Card Reader	DC power	1	100 feet
Card Control Unit and Card Punch	Data line	2	100 feet
Card Control Unit and Card Punch	Electrical Control	1	100 feet

Table A–3. Allowable Cable Lengths

APPENDIX B. SEQUENCE OF OPERATION AND TIMING

B1. GENERAL

Appendix B contains detailed timing information for programming the Punched Card Subsystem. The following paragraphs explain the time required to initiate execution of the function and the elapsed time for card movements, peripheral data transfers, translation and data movement in the buffer memory, data word assembly and disassembly, and setup time for reading and punching.

B2. INPUT FUNCTION TIMING

When a function code which specifies Condition Reader (for any mode of operation) has been decoded by the control unit, decoding takes 9 microseconds, the appropriate circuits are conditioned to accept the next function within 2 microseconds regardless of any data transfer in progress between the buffer memory and the punch. If the function code specifies "Without Interrupt", the subsystem is conditioned to accept the next function within 11 microseconds of receipt of the Condition function, and the Output Request signal is turned on. If the function code specifies "With Interrupt", the appropriate status code is generated and the External Interrupt signal is turned on within 11 microseconds of receipt of the Condition function.

When a function code which specifies Trip-No Transfer, Transfer-No Trip, or Transfer-Trip Fill is recognized by the control unit, initiation of any of the specified activities is delayed until all previous data transfers from the buffer memory to the punch have been completed. If there is no conflicting punch activity, the specified activity is initiated immediately following the decoding, subject to various reader activity timing limitations discussed below.

All of the subsystem activity required to perform a Trip One-No Transfer, Transfer-No Trip, or Transfer-Trip Fill function can be broken down into one or more of the following subfunctions:

- Feed/Read Cycle

  Feed a card from the Ready Station of the reader and load the input sense area of the buffer memory with the data read from the card.

- Translate/Move Cycle

  Move the data from the input sense area of the buffer memory to one of the two input transfer areas with either translation or a data transfer being performed.

- Input Transfer Cycle

  Read data from an input transfer area of the buffer memory and assemble the data read into words for input to the processor.

B2.1. Feed/Read Cycle Timing

This cycle is initiated if a Trip One-No Transfer function is received at a time when either the input sense area or one of the input transfer areas of the buffer memory is available to accept data from a card. It is also initiated at least once (and can be initiated up to four times) when a Transfer-Trip Fill function is received. When the control unit receives either of these functions and accepts data in its buffer memory, the card reader receives a signal to feed a card. As soon as the reader can feed a card, it informs the control unit. The three limitations on the card reader's ability to feed a card on the card reader are:

- A card must be in the Ready Station of the reader before a card can be tripped. When the first feed signal is received after loading cards in the input hopper and master clearing the subsystem, 65 milliseconds are required to move a card from the input station to the Ready Station. Once the first card has moved to the Ready Station, the next feed signal moves a card from the Ready Station to the reading path, and the next card will be moved from the input station to the Ready Station, provided there are no faults or abnormal conditions detected in the reader.

- The reader drive motor must be running at the proper operating speed before a card can be fed. If the reader drive motor runs for 30 seconds without receipt of a feed signal, the motor will automatically turn off. If a feed signal is received when the drive motor is not running, about 2 to 3 seconds are required for the motor to come up to proper operating speed before the card is fed.

- The minimum interval between feeding consecutive cards is 66.6 milliseconds. If a feed signal is received within 66.6 milliseconds of the preceding feed signal, a card is fed when the 66.6 millisecond delay expires.

When a Trip One-No Transfer function which specifies "With Interrupt" is received, the External Interrupt signal will be turned on within 11 microseconds. If the Trip-No Transfer function specifies "Without Interrupt", and no abnormal conditions are detected, the subsystem can accept the next function in 11 microseconds. This delay assumes that all previously specified Punch/Verify cycles have been completed. If this is not the case, the delay is 2 microseconds (measured from completion of the punch operation) rather than 11 microseconds (measured from receipt of the Trip-No Transfer function).

Once a card enters the reading path, 20 milliseconds are required for the first column of the card to reach the reader photocells and about 70 milliseconds for the last column to reach the reader photocells. The earliest the next card can be fed from the Ready Station to the reading path is when column 72 of the preceding card has been read. If cards are being fed at the maximum 900 card per minute rate, 17 milliseconds expire between the reading of the 80th column of one card and the first column of the next card. The time required by the buffer memory to store the 12 bits read from each column is 16 microseconds. The interval of time between reading consecutive columns is about 625 microseconds.

The "Feed/Read Cycle" is triggered once by receipt of a Trip One-No Transfer function. Multiple Feed/Read cycles can be triggered by receipt of a Transfer-Trip Fill function. This function instructs the control unit to initiate consecutive Feed/Read cycles until a card is fed when there is data from the two preceding cards in the buffer memory. For example, receiving a Transfer-Trip Fill function in a master cleared condition will normally initiate four Feed/Read cycles: the first card fed will supply data for the Input Transfer cycle required for the function, and the data from the next 3 cards will fill the 3 input areas of the buffer memory.

An unusual circumstance which can result in a Transfer-Trip Fill function initiating only 3 Feed/Read cycles (even if the function is received when the subsystem is in the master cleared condition) is the processor being so slow in responding to IDR signals that the Input Transfer cycle is not completed until the third card has been fed. On the other hand, an unlimited number of Feed/Read cycles may be initiated by receipt of a Transfer-Trip Fill function when the buffer memory does not contain data from three cards. This can occur if the processor sends a Transfer-No Trip function to the control unit following the completion of each input data transfer when there is data from one or two cards in buffer memory, but before a card is tripped when data from the two previous cards is in the buffer memory. In this case, extra Feed/Read cycles are initiated as a result of the completion of the Input Transfer cycles for each Transfer-No Trip function.

B2.2. Translate/Move Cycle Timing

The "Translate/Move Cycle" is initiated about two milliseconds after the data from the last column of a card is read and stored in the input sense area, provided the data in the input sense area can be moved to an available input transfer area. Once a Translate/Move cycle is initiated, it continues to completion without being interrupted. The Translate/Move cycle takes precedence over and will interrupt an active Input Transfer cycle. The interrupted Input Transfer Cycle will be resumed when the Translate/Move cycle is completed.

If an input transfer area is not available 2 milliseconds after completion of a Feed/Read cycle, initiation of the Translate/Move cycle is delayed until a subsequent Input Transfer cycle is completed to make an input transfer area available.

The action performed and the time required for a Translate/Move cycle is dependent on the mode for which the reader is conditioned:

- If conditioned for Translate, the Translate/Move cycle performs translation of the data in the input sense area as it is moved to an input transfer area and requires 2.56 milliseconds (80 x 32 microseconds).
- If conditioned for either Card Image mode, the Translate/Move cycle merely moves the data from the input sense area to an input transfer area and requires 5.12 milliseconds (160 x 32 microseconds).

The Translate/Move cycle must be performed for every card fed at the reader. It is triggered by the expiration of the two millisecond delay following completion of the Read portion of a Feed/Read cycle, provided there is an input transfer area available. It can also be triggered by completion of an Input Transfer cycle, provided all of the data from a card has been available in the input sense area of the buffer memory for 2 milliseconds.

B2.3. Input Transfer Cycle Timing

An Input Transfer Cycle is initiated within 9 microseconds of the receipt of a Transfer-Trip Fill function or a Transfer-No Trip function, provided a punch cycle is not active, a Translate/Move cycle is not active, and an input transfer area contains data from a card. In the case of an active punch cycle or Translate/Move cycle, initiation of the Input Transfer cycle is delayed until the conflicting cycle is completed. If there is no data in an input transfer area at the time a Transfer-Trip Fill function is received, Feed/Read cycles will be initiated and data from a card in motion (or put in motion) will be handled by a Translate/Move cycle. As soon as the Translate/Move cycle is completed, the Input Transfer cycle will begin.

If there is no data in either input transfer area at the time a Transfer-No Trip function is received, the sequence of operation depends on subsystem conditions as follows:

- If the Read portion of a Feed/Read cycle is active (part of the data from a card is in the input sense area) or if there is no data in the input sense area and the preceding function specified Trip-No Transfer (rather than Transfer-Trip Fill) initiates a Feed/Read cycle, the Feed/Read cycle is completed, then a Translate/Move cycle is completed, and then an Input Transfer cycle is initiated.
- If there is no data in the input sense area and the previous function specified Transfer-Trip Fill rather than Trip-No Transfer, an Inappropriate Function status code is generated, even though there may be a card in motion toward the reader photocells.

The time required for completion of an Input Transfer cycle depends on:

- the mode for which the reader is conditioned (Translate mode, Card image by column, or Card Image by Row),
- whether or not the Input Transfer cycle is interrupted for a Translate/Move cycle,
- the number of interruptions of the input word assembly process resulting from the need to store data for a column in the input sense area during the Read portion of a Feed/Read cycle,
- the time required for the processor to acknowledge receipt of each input data word.

The time required for word assembly is shown in Table B–1.

READER MODE	WORD ASSEMBLY TIME
Translate	48 microseconds/word (672 microseconds for 14 words)
Card Image by Column	48 microseconds/word (1,296 microseconds for 27 words)
Card Image by Row	288 microseconds/word (10,368 microseconds for 36 words)

Table B–1. Word Assembly Time

- If it is interrupted by a Translate/Move cycle, the Input Transfer cycle is extended by either 2.56 milliseconds or 5.12 milliseconds (see B2.2).
- The Input Transfer cycle is extended by 16 microseconds each time the word assembly process is interrupted by the need to store data from a card column read during a Feed/Read cycle.
- When an input word has been assembled, the minimum processor response time for each data word is 3 microseconds when the subsystem is attached to a normal I/O channel and 7 microseconds for a Compatible I/O channel.

B3. OUTPUT FUNCTION TIMING

When a function code which specifies "Condition Punch" (for any mode) is decoded by the control unit, decoding requires 9 microseconds, the appropriate circuits are conditioned within 2 microseconds regardless of the status of any Feed/Read cycle or Translate/Move cycle associated with reader activity or the status of any Punch/Verify cycle. If the function code specifies "Without Interrupt" and no abnormal conditions are detected, the subsystem is conditioned to accept the next function within 11 microseconds of the receipt of the Condition function and the Output Request signal is turned on. If the function code specifies "With Interrupt", the appropriate status code is generated and the External Interrupt signal is turned on within 11 microseconds of receipt of the Condition function.

When a function code which specifies Punch is received and decoded by the control unit, any further activity associated with the Punch function is delayed until all Feed/Read cycles and Translate/Move cycles which may be needed to properly complete any previous Trip-No Transfer or Transfer-Trip File functions are completed. If there is no conflicting Feed/Read and Translate/Move cycle activity, or when such activity is completed, the Punch function is initiated.

All of the subsystem activity required for performing a Punch function can be broken down into the following sequence of subfunctions:

- Repeated request for the appropriate number of data words from the processor, disassembly of each data word received and loading the appropriate available output transfer area with the data bits to be punched in each row of the card (called the "Output Transfer Cycle").
- Advance all cards in the Punch unit one station, feed a card from the input hopper, punch data in a card, and verify the data in the previously punched card (called the "Punch/Verify Cycle").

B3.1. Output Transfer Cycle Timing

This cycle is initiated after receipt of a Punch function when there is no conflicting reader activity and there is an output transfer area of buffer memory available to accept data to be punched. All three output transfer areas are available after master clearing the subsystem or the punch. An output transfer area is normally made available whenever a Punch/Verify cycle is completed without error detection. In the event of error detection on the initial attempt of a Punch/Verify cycle (Auto Recovery active) an output transfer area will not be made available as a result of the completion of the next two Punch/Verify cycles.

The Output Transfer cycle consists of performing the following sequence of steps either 14, 27, or 36 times:

a) Turn on the Output Request signal so the processor will send an output data word.

b) When the data word is received, disassemble the data word and load the output transfer area with bits representing the data to be punched.

The time required for the completion of an Output Transfer cycle depends on:

a) The time required by the processor to send an Output Acknowledge signal and a data word to the subsystem when responding to each Output Request signal from the subsystem.

b) The time required by the control unit to disassemble all of the data words and load the output transfer area.

c) The number of times the disassembly process must be interrupted by a series of buffer memory accesses required for the Punch/Verify cycle.

When the subsystem requests an output data word, the minimum processor response time is 3 microseconds when the subsystem is attached to a Normal I/O channel and 7 microseconds for a compatible I/O channel.

The time required for word disassembly is dependent on the mode for which the punch has been conditioned as shown in Table B–2.

During a Punch/Verify cycle the buffer memory is scanned 12 times (one for each row) at intervals of about 13.3 milliseconds. If the Output Transfer cycle is active during this scan, any access to the output transfer area required for the Output Transfer cycle is inhibited for a period of 1,280 microseconds. The delay while awaiting processor response to an Output Request signal can proceed concurrently with this 1,280-microsecond interval, but the word disassembly/output transfer area loading process cannot.

READER MODE	WORD DISASSEMBLY LOAD BUFFER MEMORY TIME
Translate	192 microseconds/word (2.688 milliseconds for 14 words)
Card Image by Column	192 microseconds/word (5.184 milliseconds for 27 words)
Card Image by Row	1,152-microseconds/word (41.472 milliseconds for 36 words)

Table B–2. Word Disassembly Time

B3.2. Transition Timing (Output Transfer Cycle Completion to Effective Punch/Verify Cycle Initiation)

Completion of an Output Transfer cycle initiates a Punch/Verify cycle provided the punch motor is running and the previous Punch/Verify cycle has reached a permissive point in its mechanical cycle.

The control unit attempts to initiate a Punch/Verify cycle by sending a feed signal to the punch unit to advance all cards one station and to feed a card from the input hopper to Wait Station 1. During any 14-second interval, the punch motor is turned off when the punch does not receive a feed signal from the control unit. If this interval expires, the punch delays further activity for about 300 milliseconds, during which time the punch motor is turned on and comes up to normal operating speed.

If the punch motor is running and the Control sends a feed signal, the Punch/Verify Cycle is delayed until the permissive point in the mechanical cycle of the preceding Punch/Verify cycle is reached. The initial permissive point occurs about 48 milliseconds before the last row in the card is punched for the preceding Punch/Verify cycle. Subsequent permissive points are reached at 40 millisecond intervals. If a feed signal intended to initiate a Punch/Verify cycle is sent to the punch, 1 millisecond to 40 milliseconds after the permissive point is reached, 40 milliseconds of punch time has been lost. If the feed signal is sent to the punch, 41 milliseconds to 80 milliseconds after the permissive point, 80 milliseconds of punch time has been lost. Therefore, if an average of 40 milliseconds punch time is lost for each card punched, the punching rate will be reduced from the maximum of 300 cards per minute to only 250 cards per minute.

B3.3. Punch/Verify Cycle Timing

Once a Punch/Verify cycle has begun, the time required for its completion is about 248 milliseconds. When punching at the maximum rate of speed of 300 cards per minute, the first 48 milliseconds of each Punch/Verify cycle overlaps the previous Punch/Verify cycle. The various increments of time which combine to make up the 248 millisecond cycle time are:

- about 28 milliseconds from the time the cycle is begun until the card to be punched starts moving from Wait Station 2 toward the punch dies,
- about 73 milliseconds from the time the card starts moving until the first row is punched,
- about 147 milliseconds from the time the first row is punched until the last row is punched.

B3.4. Punch Timing Summary for 300 CPM Operation

Table B–3 shows the nominal timing requirements (and possibilities) for maintaining a punching rate of 300 cards per minute. The times shown in the table are nominal elapsed times rounded off to the nearest millisecond. They are based on the assumption that the punch has been conditioned to operate in the Translate mode. This assumption has been reflected by using 3 milliseconds as the minimum duration of the Output Transfer cycle. The completion of the verification of the punching in the nth card has been shown as the starting reference time (T=0). It should be remembered that for the first card in a sequence to be punched, there is a mechanical cycle delay of zero to 40 milliseconds following the completion of the Output Transfer cycle before the control unit can effectively signal the punch to initiate motion of the first card to be punched from Wait Station 2 toward the punch station.

ACTIVITY	CARD n	CARD n+1	CARD n+2	CARD n+3	CARD n+4	CARD n+5	CARD n+6
Earliest possible time at which a punch function can be accepted					T=3*	T=203*	T=403*
Earliest possible time for start of Output Transfer Cycle (Output Request signal turned on to request the first data word to be punched in a card)				T=0	200	400	600
Earliest possible time for completion of the Output Transfer Cycle (Last word of data to be punched in a card has been stored in the buffer memory and the EI signal turned on for a Punch with Interrupt function)				3*	203*	403*	603*
Latest possible time for receipt of a Punch Function (and still maintain 300 CPM punching rate)				149*	349*	549*	749*
Latest possible time for start of Output Transfer Cycle				149*	349*	549*	749*
Latest possible time for completion of the Output Transfer Cycle				152	352	552	752
Control unit must signal Punch to advance card through punch station in order to maintain 300 CPM punching rate				152	352	552	752
Card starts motion from Wait Station 2 to Punch station				180	380	580	780
First row of card punched			T=53	253	453	653	853
Last row of card punched		T=0	200	400	600	800	1,000
First row of card verified		53	253	453	653	853	1,053
Last row of card verified	T=0	200	400	600	800	1,000	1,200

**Assumed Punch is conditioned for Translate Mode so that an Output Transfer Cycle can be completed in 3 milliseconds.*

Table B–3. Nominal Timing Details for 300 CPM Punching Rate

UNIVAC

DIVISION OF SPERRY RAND CORPORATION

UP-7506